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10009119

PATENT COOPERATION TREATY

PCT

RECEIVED
JUL 30 2002
Technology Center 2600

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
SK01PCT25		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/JP 01/01982	13/03/2001	13/03/2000
Applicant		
SONY CORPORATION et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 1 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 5

   [ ] as suggested by the applicant.

   [X] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 01/01982

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/26 G06F17/30 H04N7/24 H04N7/50 H04N7/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06F H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, INSPEC, COMPENDEX, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 52356 A (CHANG SHIH FU ;UNIV COLUMBIA (US); MENG JIANHAO (US)) 19 November 1998 (1998-11-19) page 10, line 24 -page 11, line 29 page 13, line 30 -page 17, line 16 page 20, line 1 -page 21, line 3 page 22, line 20 -page 24, line 11 figures 9A,9B,13	1-12, 19-21, 24-58
Y		13-17
A		18,22,23

	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 October 2001	09/11/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Lombardi, G

1

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	"PROPOSED SMPTE STANDARD FOR TELEVISION-MPEG-2 VIDEO RECODING DATA SET" SMPTE JOURNAL, SMPTE INC. SCARSDALE, N.Y, US, vol. 109, no. 2, February 2000 (2000-02), pages 146-150, XP000913023 ISSN: 0036-1682 cited in the application page 1, paragraph 3 page 2, paragraph 5 page 3, paragraph 6 tables 1-3	1-4, 24-43, 45,56,57
A		5-23,44, 46-55,58

X	GUNSEL B ET AL: "Content-based access to video objects: Temporal Segmentation, visual summarization, and feature extraction" SIGNAL PROCESSING. EUROPEAN JOURNAL DEVOTED TO THE METHODS AND APPLICATIONS OF SIGNAL PROCESSING, ELSEVIER SCIENCE PUBLISHERS B.V. AMSTERDAM, NL, vol. 66, no. 2, 30 April 1998 (1998-04-30), pages 261-280, XP004129645 ISSN: 0165-1684 page 264, paragraph 2 page 267, paragraph 3 page 270, paragraph 5	53,54,58
Y		13,14,17
A		1,5-12, 18,22,23

Y	CHUN K W ET AL: "An adaptive perceptual quantization algorithm for video coding" IEEE 1993 INTERNATIONAL CONFERENCE ON CONSUMER ELECTRONICS. ICCE, ROSEMONT, IL, USA, 8-10 JUNE 1993, vol. 39, no. 3, pages 555-558, XP002180113 IEEE Transactions on Consumer Electronics, Aug. 1993, USA ISSN: 0098-3063 cited in the application page 556, paragraph III.A; figure 4	15,16
A		1,5

	-/--	

1

INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 01/01982

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	WEE S J ET AL: "FIELD-TO-FRAME TRANSCODING WITH SPATIAL AND TEMPORAL DOWNSAMPLING" PROCEEDINGS 1999 INTERNATIONAL CONFERENCE ON IMAGE PROCESSING. ICIP'99. KOBE, JAPAN, OCT. 24 - 28, 1999, INTERNATIONAL CONFERENCE ON IMAGE PROCESSING, LOS ALAMITOS, CA: IEEE, US, vol. 4 OF 4, 24 October 1999 (1999-10-24), pages 271-275, XP000895525 ISBN: 0-7803-5468-0 page 273, paragraph 5 ---	1-4, 24-43
A	ISO/IEC AD HOC GROUP ON MPEG-4 VIDEO VM EDITING: "MPEG-4 Video Verification Model Version 13.0 ISO/IEC JTC1/SC29/WG11 MPEG97/N2687" INTERNATIONAL ORGANIZATION FOR STANDARDIZATION - ORGANISATION INTERNATIONALE DE NORMALISATION, March 1999 (1999-03), pages 1-347, XP002177336 page 166, paragraph 5.5 page 324, paragraph 16.11 -----	1-58

1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/JP 01/01982

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9852356 A	19-11-1998	WO 9852356 A1	19-11-1998

10/009,109

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 September 2001 (20.09.2001)

PCT

(10) International Publication Number
WO 01/69936 A3

(51) International Patent Classification[7]: H04N 7/26, G06F 17/30, H04N 7/24, 7/50, 7/36

(21) International Application Number: PCT/JP01/01982

(22) International Filing Date: 13 March 2001 (13.03.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2000-68720 13 March 2000 (13.03.2000) JP
60/204,729 16 May 2000 (16.05.2000) US

(71) Applicant *(for all designated States except US)*: **SONY CORPORATION** [JP/JP]; 7-35, Kitashinagawa 6-chome, Shinagawa-ku, Tokyo 141-0001 (JP).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **KUHN, Peter** [DE/JP]; c/o SONY CORPORATION, 7-35, Kitashinagawa 6-chome, Shinagawa-ku, Tokyo 141-0001 (JP).

(74) Agents: **KOIKE, Akira** et al.; No.11 Mori Bldg., 6-4, Toranomon 2-chome, Minato-ku, Tokyo 105-0001 (JP).

(81) Designated States *(national)*: AU, CA, CN, JP, KR, US.

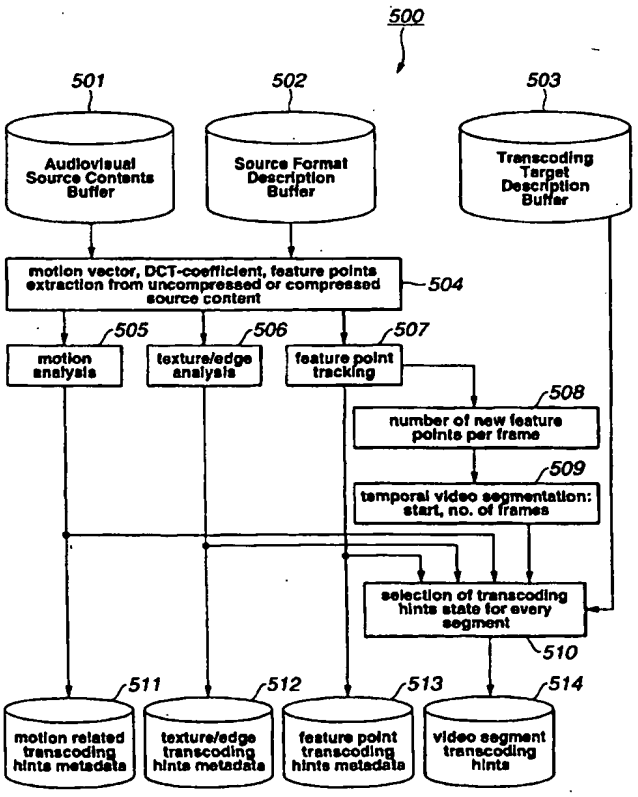
(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

Published:
— *with international search report*

(88) Date of publication of the international search report:
28 February 2002

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR GENERATING COMPACT TRANSCODING HINTS METADATA



(57) Abstract: An audio/video (or audiovisual, "A/V") signal processing apparatus and method for extracting a compact representation of a multimedia description and transcoding hints metadata for transcoding between different (e.g., MPEG) compressed content representations, manipulating (e.g., MPEG compressed) bitstream parameters such as frame rate, bit rate, session size, quantization parameters, and picture coding type structure (e.g., group of pictures, or "GOP"), classifying A/V content, and retrieving multimedia information.

WO 01/69936 A3

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF RECEIPT OF RECORD COPY

(PCT Rule 24.2(a))

To:

KOIKE, Akira
No.11 Mori Bldg., 6-4, Toranomon 2-chome
Minato-ku, Tokyo 105-0001
JAPON

Date of mailing (day/month/year)	**IMPORTANT NOTIFICATION**
03 April 2001 (03.04.01)	
Applicant's or agent's file reference	**International application No.**
SK01PCT25	PCT/JP01/01982

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

SONY CORPORATION (for all designated States except US)
KUHN, Peter (for US)

International filing date	:	13 March 2001 (13.03.01)
Priority date(s) claimed	:	13 March 2000 (13.03.00) 16 May 2000 (16.05.00)
Date of receipt of the record copy by the International Bureau	:	26 March 2001 (26.03.01)
List of designated Offices	:	

EP :AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE,TR
National :AU,CA,CN,JP,KR,US

ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- [X] time limits for entry into the national phase
- [X] confirmation of precautionary designations
- [ ] requirements regarding priority documents

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer:

Y. KUWAHARA

Telephone No. (41-22) 338.83.38

INFORMATION ON TIME LIMITS FOR ENTERING THE NATIONAL PHASE

The applicant is reminded that the "national phase" must be entered before each of the designated Offices indicated in the Notification of Receipt of Record Copy (Form PCT/IB/301) by paying national fees and furnishing translations, as prescribed by the applicable national laws.

The time limit for performing these procedural acts is **20 MONTHS** from the priority date or, for those designated States which the applicant elects in a demand for international preliminary examination or in a later election, **30 MONTHS** from the priority date, provided that the election is made before the expiration of 19 months from the priority date. Some designated (or elected) Offices have fixed time limits which expire even later than 20 or 30 months from the priority date. In other Offices an extension of time or grace period, in some cases upon payment of an additional fee, is available.

In addition to these procedural acts, the applicant may also have to comply with other special requirements applicable in certain Offices. **It is the applicant's responsibility** to ensure that the necessary steps to enter the national phase are taken in a timely fashion. Most designated Offices do not issue reminders to applicants in connection with the entry into the national phase.

For detailed information about the procedural acts to be performed to enter the national phase before each designated Office, the applicable time limits and possible extensions of time or grace periods, and any other requirements, see the relevant Chapters of Volume II of the PCT Applicant's Guide. Information about the requirements for filing a demand for international preliminary examination is set out in Chapter IX of Volume I of the PCT Applicant's Guide.

GR and ES became bound by PCT Chapter II on 7 September 1996 and 6 September 1997, respectively, and may, therefore, be elected in a demand or a later election filed on or after 7 September 1996 and 6 September 1997, respectively, regardless of the filing date of the international application. (See second paragraph above.)

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

CONFIRMATION OF PRECAUTIONARY DESIGNATIONS

This notification lists only specific designations made under Rule 4.9(a) in the request. It is important to check that these designations are correct. Errors in designations can be corrected where precautionary designations have been made under Rule 4.9(b). The applicant is hereby reminded that any precautionary designations may be confirmed according to Rule 4.9(c) before the expiration of 15 months from the priority date. If it is not confirmed, it will automatically be regarded as withdrawn by the applicant. There will be no reminder and no invitation. Confirmation of a designation consists of the filing of a notice specifying the designated State concerned (with an indication of the kind of protection or treatment desired) and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.

REQUIREMENTS REGARDING PRIORITY DOCUMENTS

For applicants who have not yet complied with the requirements regarding priority documents, the following is recalled.

Where the priority of an earlier national, regional or international application is claimed, the applicant must submit a copy of the said earlier application, certified by the authority with which it was filed ("the priority document") to the receiving Office (which will transmit it to the International Bureau) or directly to the International Bureau, before the expiration of 16 months from the priority date, provided that any such priority document may still be submitted to the International Bureau before that date of international publication of the international application, in which case that document will be considered to have been received by the International Bureau on the last day of the 16-month time limit (Rule 17.1(a)).

Where the priority document is issued by the receiving Office, the applicant may, instead of submitting the priority document, request the receiving Office to prepare and transmit the priority document to the International Bureau. Such request must be made before the expiration of the 16-month time limit and may be subjected by the receiving Office to the payment of a fee (Rule 17.1(b)).

If the priority document concerned is not submitted to the International Bureau or if the request to the receiving Office to prepare and transmit the priority document has not been made (and the corresponding fee, if any, paid) within the applicable time limit indicated under the preceding paragraphs, any designated State may disregard the priority claim, provided that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity to furnish the priority document within a time limit which is reasonable under the circumstances.

Where several priorities are claimed, the priority date to be considered for the purposes of computing the 16-month time limit is the filing date of the earliest application whose priority is claimed.

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

KOIKE, Akira
No.11 Mori Bldg., 6-4, Toranomon 2-chome
Minato-ku, Tokyo 105-0001
JAPON

Date of mailing (day/month/year) 03 April 2001 (03.04.01)	
Applicant's or agent's file reference SK01PCT25	**IMPORTANT NOTIFICATION**
International application No. PCT/JP01/01982	International filing date (day/month/year) 13 March 2001 (13.03.01)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 13 March 2000 (13.03.00)
Applicant SONY CORPORATION et al	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.

3. An **asterisk(*)** appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

4. The **letters "NR"** appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
13 Marc 2000 (13.03.00)	2000-068720	JP	26 Marc 2001 (26.03.01)
16 May 2000 (16.05.00)	60/204,729	US	26 Marc 2001 (26.03.01)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

Y. KUWAHARA

Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:
KOIKE, Akira
No.11 Mori Bldg., 6-4, Toranomon 2-chome
Minato-ku, Tokyo 105-0001
JAPON

Date of mailing (day/month/year) 20 September 2001 (20.09.01)	
Applicant's or agent's file reference SK01PCT25	**IMPORTANT NOTICE**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/JP01/01982	13 March 2001 (13.03.01)	13 March 2000 (13.03.00)

Applicant
SONY CORPORATION et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   KR,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   AU,CA,CN,EP,JP

   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   20 September 2001 (20.09.01) under No. WO 01/69936

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, **a demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer
J. Zahra

Telephone No. (41-22) 338.83.38

PCT REQUEST

SK01PCT25

Duplicate of original printed on13.03.2001 03:46:20 PM

0	**For receiving Office use only**	
0-1	International Application No.	
0-2	International Filing Date	PCT 13.3.01 受領印
0-3	Name of receiving Office and "PCT International Application"	

0-4	**Form - PCT/RO/101 PCT Request**	
0-4-1	Prepared using	PCT-EASY Version 2.91 (updated 01.01.2001)
0-5	**Petition**	
	The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	**Receiving Office (specified by the applicant)**	Japanese Patent Office (RO/JP)
0-7	**Applicant's or agent's file reference**	SK01PCT25
I	**Title of invention**	METHOD AND APPARATUS FOR GENERATING COMPACT TRANSCODING HINTS METADATA
II	**Applicant**	
II-1	This person is:	applicant only
II-2	Applicant for	all designated States except US
II-4	Name	SONY CORPORATION
II-5	Address:	7-35, Kitashinagawa 6-chome Shinagawa-ku, Tokyo 141-0001 Japan
II-6	State of nationality	JP
II-7	State of residence	JP
III-1	**Applicant and/or inventor**	
III-1-1	This person is:	applicant and inventor
III-1-2	Applicant for	US only
III-1-4	Name (LAST, First)	KUHN, Peter
III-1-5	Address:	c/o SONY CORPORATION 7-35, Kitashinagawa 6-chome Shinagawa-ku, Tokyo 141-0001 Japan
III-1-6	State of nationality	DE
III-1-7	State of residence	JP

PCT REQUEST

SK01PCT25

Duplicate of original printed on13.03.2001 03:46:20 PM

IV-1	**Agent or common representative; or address for correspondence** The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name (LAST, First)	KOIKE, Akira
IV-1-2	Address:	No.11 Mori Bldg., 6-4, Toranomon 2-chome Minato-ku, Tokyo 105-0001 Japan
IV-1-3	Telephone No.	03-3508-8266
IV-1-4	Facsimile No.	03-3508-0439
IV-2	**Additional agent(s)**	additional agent(s) with same address as first named agent
IV-2-1	Name(s)	TAMURA, Eiichi; IGA, Seiji
V	**Designation of States**	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE TR and any other State which is a Contracting State of the European Patent Convention and of the PCT
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AU CA CN JP KR US
V-5	**Precautionary Designation Statement** In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.	
V-6	**Exclusion(s) from precautionary designations**	NONE
VI-1	**Priority claim of earlier national application**	
VI-1-1	Filing date	13 March 2000 (13.03.2000)
VI-1-2	Number	Patent Application 2000-068720
VI-1-3	Country	JP
VI-2	**Priority claim of earlier national application**	
VI-2-1	Filing date	16 May 2000 (16.05.2000)
VI-2-2	Number	60/204,729
VI-2-3	Country	US

PCT REQUEST SK01PCT25

Duplicate of original printed on13.03.2001 03:46:20 PM

VII-1	**International Searching Authority Chosen**	European Patent Office (EPO) (ISA/EP)	
VIII	**Check list**	number of sheets	electronic file(s) attached
VIII-1	Request	4	-
VIII-2	Description	34	-
VIII-3	Claims	18	-
VIII-4	Abstract	1	EZABST00.TXT
VIII-5	Drawings	13	-
VIII-7	TOTAL	70	
	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	-
VIII-10	Copy of general power of attorney	reference no. <no.>	-
VIII-12	Priority document(s)	Item(s) VI-1, VI-2	-
VIII-16	PCT-EASY diskette	-	diskette
VIII-17	Other (specified):	Revenue stamps of transmittal fee for receiving office	-
VIII-17	Other (specified):	Submission of certificate of payment for search fee	-
VIII-17	Other (specified):	Submission of certificate of payment for international fee	-
VIII-18	**Figure of the drawings which should accompany the abstract**	1	
VIII-19	**Language of filing of the international application**	English	
IX-1	**Signature of applicant or agent**		
IX-1-1	Name (LAST, First)	KOIKE, Akira	
IX-2	**Signature of applicant or agent**		
IX-2-1	Name (LAST, First)	TAMURA, Eiichi	
IX-3	**Signature of applicant or agent**		
IX-3-1	Name (LAST, First)	IGA, Seiji	

FOR RECEIVING OFFICE USE ONLY

10-1	**Date of actual receipt of the purported international application**	
10-2	**Drawings:**	
10-2-1	Received	
10-2-2	Not received	

PCT REQUEST SK01PCT25

Duplicate of original printed on13.03.2001 03:46:20 PM

10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/EP
10-6	Transmittal of search copy delayed until search fee is paid	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	Date of receipt of the record copy by the International Bureau	

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 September 2001 (20.09.2001)

PCT

(10) International Publication Number
WO 01/69936 A2

(51) International Patent Classification[7]: H04N 7/26

(21) International Application Number: PCT/JP01/01982

(22) International Filing Date: 13 March 2001 (13.03.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2000-68720 13 March 2000 (13.03.2000) JP
60/204,729 16 May 2000 (16.05.2000) US

(71) Applicant *(for all designated States except US)*: **SONY CORPORATION** [JP/JP]; 7-35, Kitashinagawa 6-chome, Shinagawa-ku, Tokyo 141-0001 (JP).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **KUHN, Peter** [DE/JP]; c/o SONY CORPORATION, 7-35, Kitashinagawa 6-chome, Shinagawa-ku, Tokyo 141-0001 (JP).

(74) Agents: **KOIKE, Akira** et al.; No.11 Mori Bldg., 6-4, Toranomon 2-chome, Minato-ku, Tokyo 105-0001 (JP).

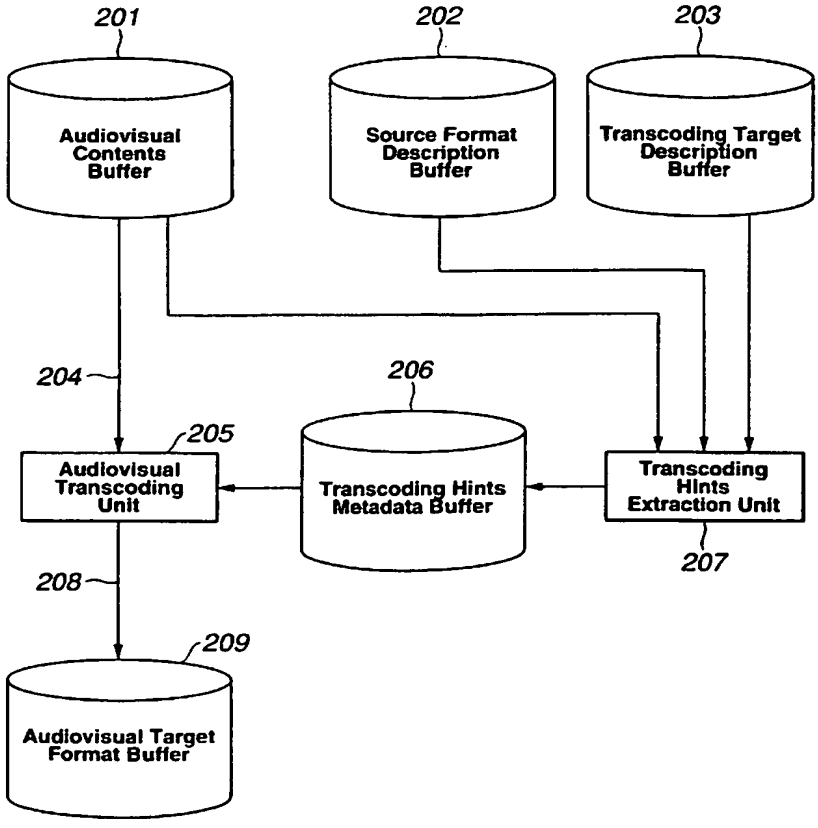
(81) Designated States *(national)*: AU, CA, CN, JP, KR, US.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR GENERATING COMPACT TRANSCODING HINTS METADATA



(57) Abstract: An audio/video (or audiovisual, "A/V") signal processing apparatus and method for extracting a compact representation of a multimedia description and transcoding hints metadata for transcoding between different (e.g., MPEG) compressed content representations, manipulating (e.g., MPEG compressed) bitstream parameters such as frame rate, bit rate, session size, quantization parameters, and picture coding type structure (e.g., group of pictures, or "GOP"), classifying A/V content, and retrieving multimedia information.

WO 01/69936 A2

DESCRIPTION

Method and Apparatus for Generating Compact Transcoding Hints Metadata

Technical Field

The present invention relates to an audio/video (or audiovisual, "A/V") signal processing method and an A/V signal processing apparatus for extracting a compact representation of a multimedia description and transcoding hints metadata for transcoding between different (e.g., MPEG) compressed content representations, manipulating (e.g., MPEG compressed) bitstream parameters such as frame rate, bit rate, session size, quantization parameters, and picture coding type structure, such as group of pictures, or "GOP", classifying A/V content, and retrieving multimedia information.

Background Art

A/V content is increasingly being transmitted over optical, wireless, and wired networks. Since these networks are characterized by different network bandwidth constraints, there is a need to represent A/V content by different bit rates resulting in varying subjective visual quality. Additional requirements on the compressed representation of A/V content are imposed by the screen size, computational capabilities, and memory constraints of an A/V terminal.

Therefore, A/V content stored in a compressed format, e.g., as defined by

Moving Pictures Experts Group ("MPEG"), must be converted to, e.g., different bit rates, frame rates, screen sizes, and in accordance with varying decoding complexities and memory constraints of different A/V terminals.

To avoid the need for storing multiple compressed representations of the same A/V content for different network bandwidths and different A/V terminals, A/V content stored in a compressed MPEG format may be transcoded to a different MPEG format.

With respect to video transcoding, reference is made to the following:

W009838800A1: O. H. Werner, N. D. Wells, M. J. Knee: Digital Compression Encoding with improved quantization, 1999, proposes an adaptive quantization scheme;

US5870146: Zhu; Qin-Fan: Device and method for digital video transcoding, 1999;

W009929113A1: Nilsson, Michael, Erling; Ghanbari, Mohammed: Transcoding, 1999;

US5805224: Keesman; Gerrit J, Van Otterloo; Petrus J.: Method and Device for Transcoding Video Signal, 1998;

W009943162AL Golin, Stuart, Jay: Motion vector extrapolation for transcoding video sequences, 1999;

US5838664: Polomski; Mark D.: Video teleconferencing system with digital transcoding, 1998;

W009957673A2: Balliol, Nicolas: Transcoding of a data stream, 1999;

US5808570: Bakhmutsky; Michael: Device and Method for pair-matching Huffman-Transcoding and high performance variable length decoder with two-word bitstream segmentation which utilizes the same, 1998;

W009905870A2: Lemaguet, Yann: Method of Switching between Video Sequences and corresponding Device, 1999; and

W009923560A1: LUDWIG, Lester; BROWN, William; YUL, Inn, J.; VUONG, Anh, T., VANDERLIPPE, Richard; BURNETT, Gerald; LAUWERS, Chris; LUI, Richard; APPLEBAUM, Daniel: Scalable networked multimedia system and application, 1999.

However, none of these patents on video transcoding disclose or suggest using transcoding hints metadata information to facilitate A/V transcoding.

The Society of Motion Picture and Television ("SMPTE") proposed a standard for Television on MPEG-2 Video Recoding Data Set (327M-2000), which provides for re-encoding metadata using 256 bits for every macroblock of the source format. However, this extraction and representation of transcoding hints metadata has several disadvantages. For example, according to the proposed standard, transcoding hints metadata (such as GOP structure, quantizer settings, motion vectors, etc.) is extracted for every single frame and macroblock of the A/V source content. This method offers the advantage of offering detailed and content adaptive transcoding hints and facilitates transcoding while widely preserving the subjective A/V duality. However, the size of

the transcoding hints metadata is very large. In one specific implementation of the proposed standard, 256 bits of transcoding hints metadata are stored per macroblock of MPEG video. This large amount of transcoding hints metadata is not feasible for, say, broadcast distribution to a local (e.g., home) A/V content server. Consequently, the proposed standard on transcoding hints metadata is limited to broadcast studio applications.

Another technique for transcoding hints metadata extraction and representation includes collecting general transcoding hints metadata for the transcoding of compressed A/V source content with a specific bit rate to another compressed format and bit rate. However, this technique is disadvantageous in not taking the characteristic properties of the transcoded content into account. For example, in the source content, the A/V characteristics may change from an A/V segment with limited amount of motion and few details (e.g., a news anchor scene) to another A/V segment depicting fast motion and numerous details (e.g., a sports event scene). According to this technique, misleading transcoding hints metadata, which would not suitably represent the different characteristics of both video segments, would be selected and, therefore, result in poor A/V quality and faulty bit rate allocation.

Disclosure of the Invention

In view of the foregoing, it is an object of the present invention to provide a method and apparatus for extracting a compact and A/V-content adaptive multimedia description and transcoding hints metadata representation.

It is another object of the invention to provide a transcoding method and apparatus that allow for real-time execution without significant delay and inhibitive computational complexity one of the requirements for a transcoding method. A second requirement for a transcoding method is to preserve the subjective A/V quality as much as possible. To facilitate a transcoding method that fulfills both of these requirements for various compressed target formats, transcoding hints metadata may be generated in advance and stored separately or together with the compressed A/V content. It is a further object of this invention to provide a highly compact representation to reduce storage size and to facilitate distribution (e.g., broadcast to local A/V content server) of multimedia description and transcoding hints metadata.

It is, thus, an object of the invention to provide a transcoding system that: 1) preserves the A/V quality through the transcoding process, and 2) limits the computational complexity in order to enable real-time applications with minimal delay. In accordance with an embodiment of the invention, additional data (metadata) covering transcoding hints may be associated to the compressed A/V content.

Other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification and the drawings.

The present invention is directed to an apparatus and method that provides automatic

transcoding hints metadata extraction and compact representation.

The present invention is in the field of transcoding compressed A/V content from one compressed format into A/V content of another format by using supporting transcoding metadata. The term transcoding includes, but is not limited to changing the compressed format (e.g. conversion from MPEG-2 format to MPEG-4 format), frame-rate conversion, bit rate-conversion, session-size conversion, screen-size conversion, picture coding type conversions, etc.

The present invention may also be applied to automatic video classification using the aforementioned transcoding hints states as classes of different scene activity in video.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others, and the apparatus embodying features of construction, combination(s) of elements and arrangement of parts that are adapted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the invention will be indicated in the claims.

Brief Description of the Drawings

For a more complete understanding of the invention, reference is made to the following description and accompanying drawing(s), in which:

Fig. 1 depicts a system overview of a transcoding system in a home network with various A/V terminals in accordance with an embodiment of the invention;

Fig. 2 illustrates the transcoding hints extraction (Group of Pictures, "GOP") in

accordance with an embodiment of the invention;

Fig. 3 illustrates an example for the selection of transcoding states depending on the number of new feature points per frame according to an embodiment of the invention;

Fig. 4 shows an example of a transcoding hints state diagram with 3 states according to an embodiment of the invention;

Fig. 5 illustrates the transcoding hints metadata extraction from compressed and uncompressed source content in accordance with an embodiment of the invention;

Fig. 6 shows a video segmentation and transcoding hints state selection process in accordance with an embodiment of the invention;

Fig. 7 shows a method of determining the boundaries of a new video segment (or new GOP) in accordance with an embodiment of the invention;

Fig. 8 shows an algorithm on how to select the transcoding hints state in accordance with an embodiment of the invention;

Fig. 9 provides an overview of a structural organization of transcoding hints metadata in accordance with an embodiment of the invention;

Fig. 10 depicts a structural organization of a general transcoding hints metadata description scheme according to an embodiment of the invention;

Fig. 11 depicts the transcoding hints metadata for source format definition according to an embodiment of the invention;

Fig. 12 depicts the transcoding hints metadata for target format definition

according to an embodiment of the invention;

Fig. 13 depicts the general transcoding hints metadata representation according to an embodiment of the invention;

Fig. 14 depicts the segment-based transcoding hints metadata representation according to an embodiment of the invention;

Fig. 15 depicts the encoding complexity transcoding hints metadata according to an embodiment of the invention; and

Fig. 16 depicts the transcoding hints state metadata according to an embodiment of the invention.

Best Mode for Carrying out the Invention

Fig. 1 depicts a general overview on a system 100 for transcoding in a home network environment in accordance with an embodiment of the invention. As shown in Fig. 1, an A/V content server 102 includes an A/V content storage 103, an A/V transcoding unit 106, a transcoding hints metadata extraction unit 104, and an A/V transcoding hints metadata storage buffer 105. A/V content storage 103 stores compressed A/V material from various sources with varying bit rate and varying subjective quality. For example, A/V content storage 103 may contain home video from a portable Digital Video ("DV") video camera 111, MPEG-4 compressed video with a very low bit rates (of say 10 kbit/s) from an MPEG-4 Internet camera 112, and MPEG-2 Main Profile at Main Level ("MP@ML") compressed broadcast video of

around 5 Mbit/s from a broadcast service 101, which is in some cases already associated with transcoding hints metadata. A/V content server 102 may also contain high definition compressed MPEG video at considerably higher bit rates.

As shown in Fig. 1, A/V content server 102 is connected to a network 113, which may be a wire-based or wireless home network. Several A/V terminals with different characteristics may also be attached to network 113, including, but not limited to: a wireless MPEG-4 A/V personal digital assistant ("PDA") 107, a high resolution A/V terminal for high definition television entertainment 108, an A/V game console 109, and an International Telecommunications Union Technical Standards Group ("ITU-T") based videophone 110. The A/V terminals 107, 108, 109, and 110 may be attached with different bit rate transmission capabilities (due to cable or radio link) to home network 113.

Furthermore, wireless video PDA 107, for example, may be limited in terms of computational power, storage memory, screen size, video frame rate, and network bit rate. Therefore, A/V transcoding unit 106 may transcode, for example, 5 Mbit/s MPEG-2 broadcast video at European 25 frames per second ("fps") and 720x 480 pel contained in A/V content server 102 to an MPEG-4 500 kbit/s 15 fps video for wireless transmission and display on a 352x240 pel display by wireless MPEG-4 video PDA 107. A/V transcoding unit 106 may use the transcoding hints metadata from buffer 105 to transcode, in real time, the compressed source bit rate of the A/V content to the capabilities of each specific target A/V terminal 107, 108, 109, and 110. The

transcoding hints metadata are generated in transcoding hints metadata extraction unit 104 or they may be distributed by a broadcast service 101.

As shown in Fig. 1, a compressed bitstream in a source format (hereinafter "first bitstream") 116 is transferred from A/V content buffer 103 to A/V transcoding unit 106. A bitstream in a target format (hereinafter "second bitstream") 115 is transferred after transcoding in transcoding unit 106 to home network 113. From home network 113, content in, e.g., compressed DV format is stored in A/V content storage 103 via link 114.

Fig. 2 illustrates the transcoding hints extraction, transcoding hints storage, and transcoding process in accordance with an embodiment of the invention. As shown in Fig. 2, a buffer 201 contains A/V content in a source format. A buffer 202 contains a description of the source format, such as bit rate, compression method, GOP structure, screen size, interlaced or progressive format, etc. A buffer 203 contains a description of a target format, such as bit rate, compression method, GOP structure, screen size, interlaced or progressive format, etc. A transcoding hints extraction unit 207 reads the A/V content in compressed source format from A/V buffer 201, as well as the source format description from buffer 202 and the transcoding target format description from buffer 203. After the transcoding hints are calculated by transcoding hints extraction unit 207, the transcoding hints are stored in a transcoding hints metadata buffer 206. An A/V transcoding unit 205 reads first bitstream 204 in the source format from A/V content buffer 201 and transforms the source format into the target format by means of the transcoding hints metadata stored in buffer 206. A/V transcoding unit 205

outputs second bitstream 208 in the new compressed target format to an A/V target format buffer 209 for storage.

Figs. 3 and 4 illustrate the principle of transcoding hints metadata organization in accordance with an embodiment of the invention. MPEG-based video compression uses a predictable method, where changes between successive frames are encoded. Video content with a large number of changes from one frame to the next frame requires (for maintaining the subjective quality while limiting the bit rate) different re-encoding parameter settings, than video content with small changes between frames. Therefore, it is important to decide in advance on the re-encoding parameters. The transcoding hints metadata selection mainly depends on amount and characteristics of unpredictable visual content. The new visual content may not be predicted from previous frames and may be bit rate intensive encoded using DCT-coefficients. As such, the inventive method uses the number of new feature points, which are not tracked from a previous frame to a current frame to determine the amount of new content per frame.

Fig. 3 depicts a graph of the number of new feature points per frame depending on the frame number of a video (horizontal axis, time axis). Section 301 is a part of a video segment where only a very small amount of new content appears between succeeding frames, and therefore respective transcoding hints metadata (e.g., large GOP size, low frame rate, low bit rate, ...) may be chosen. Section 302 includes a slightly higher number of new feature points per frame, which means that a state

describing transcoding hints metadata is chosen, which provides optimum transcoding parameters for this situation (e.g., slightly smaller GOP size, higher bit rate). Section 303 depicts a transcoding metadata hints state with a high number of new feature points per frame, and therefore a high amount of new content per scene. As such, a smaller M value (I/P-frame distance) and a higher bit rate are chosen.

Fig. 4 depicts an example of the basic organization of a transcoding hints metadata state diagram consisting of three discrete transcoding hints metadata states. Every discrete transcoding state may contain metadata for GOP structure, quantizer parameters, bit rate, screen size, etc. These transcoding hint parameters may have a fixed value or may be a function of another parameter. For example, the GOP length may be a discrete function of the number of new feature points per frame and the quantizer parameters may be a function of the edge and texture activity derived from the DCT coefficients. Each of the three transcoding hints metadata states in this example may be selected to accommodate three different encoding situations. As shown in Fig. 4, state "3" 403 is selected for a high amount of motion and low amount of new content per frame and represents the optimum state for transcoding hints metadata for such content. State "2" 402 is selected for low amount of motion and high amount of content with high edge activity, which may require a high number of bits to be spent. State "1" 401 is, for example, selected to accommodate the transcoding process for A/V content with low scene activity. There are also other special transcoding hint metadata states provided for video editing effects, like

different crossfading effects, abrupt scene changes, or black pictures between two scenes. The location of the video editing effects may be detected manually, semi-automatically, or fully automatically.

Fig. 5 illustrates the transcoding hints metadata extraction from compressed and uncompressed source content in accordance with an embodiment of the invention. As shown in Fig. 5, a system 500 includes an A/V source content buffer 501, a source format description buffer 502, and a target format description buffer 503.

A memory 504 is included for storing the motion vector, DCT-coefficient, and feature point extraction from compressed or uncompressed domains. In the compressed domain, motion vector from P- and B-macroblocks may be directly extracted from a bitstream. However, there are no motion vectors, for Intra-macroblocks. Therefore, the motion vectors obtained for B- and P- macroblocks may be interpolated for I-macroblocks (see Roy Wang, Thomas Huang: "Fast Camera motion Analysis in MPEG domain", IEEE International Conference on Image Processing, ICIP 99, Kobe, Japan, Oct 1999). DCT coefficients for blocks of Intra-macroblocks may be directly extracted from a bitstream. For P- and B-macroblocks, a limited number of DCT-coefficients (DC and 2 AC coefficients) may be obtained by the method described by Shih-Fu Chang, David G. Messerschmid: "Manipulation and Composition of MC-DCT compressed video", IEEE Journal on Selected Areas in Communications, vol. 8, 1996. Exemplary methods of compressed domain feature point extraction and motion estimation is disclosed in the patent by

Peter Kuhn: "Method and Apparatus for compressed domain feature point registration and motion estimation", PCT patent, December 1999, which is incorporated herein by reference. In some cases, the A/V source content may only be available in uncompressed format or in a compression format that is not based on the DCT and motion compensation principle, which is employed by MPEG- 1, MPEG-2, MPEG-4, ITU-T H.261, and ITU-T H.263. For the DV format, it may be the case that only the DCT-coefficients are available. In these cases motion vectors may be obtained by motion estimation methods, cf. e.g. Peter Kuhn. "Algorithms, Complexity Analysis and VLSI Architectures for MPEG-4 Motion Estimation", Kluwer Academic Publishers, 1999. DCT-coefficients may be obtained by performing a block-based DCT-transform, cf. K.R. Rao, P. Yip: "Discrete Cosine Transform - Algorithms, Advantages, Applications", Academic Press 1990. Feature points in pel domain (uncompressed domain) may be obtained for example by the method described by Bruce D. Lucas, Takeo Kanade: "An iterative registration technique with an application to stereo vision", International Joint Conference on Artificial Intelligence, pp. 674-679, 1981.

A motion analysis part 505 extracts the parameters of a parametric motion model from the motion vector representation in memory 504. Parametric motion models may have 6 and 8 parameters and parametric motion estimation may be obtained by methods described in M. Tekalp: "Digital Video Processing", Prentice Hall, 1995. The goal of using a motion representation is to eliminate the motion

estimation in the transcoder for delay and speed reasons. Therefore, the input representation of motion from the source bitstream may be used to derive the output representation (target bitstream). For example, screen-size resizing, interlaced-progressive conversion, etc., may rely heavily on the motion representation. The parameters of the motion representation may also be used for coding decisions on GOP structure. A texture/edge analysis part 506 may be based on the DCT-coefficients extracted from the bitstream, e.g., K.R. Rao, P Yip: "Discrete Cosine Transform - Algorithms, Advantages, Applications", Academic Press 1990, or K.W. Chun, K.W. Lim, H. D. Cho, J.B. Ra: "An adaptive perceptual quantization algorithm for video encoding, IEEE Transactions on Consumer Electronics, Vol. 39, No. 3, August 1993.

A feature point tracking part 507 for the compressed domain may employ a technique described in Peter Kuhn. "Method and Apparatus for compressed domain feature point registration and motion estimation", PCT patent, December 1999, which is incorporated herein by reference. A processor 510 calculates the number of new feature points per frame. A processor 509 calculates the temporal video segmentation, and a processor 510 calculates the transcoding hints state for every segment. Methods for these calculations according to an embodiment of the invention will be described in detail below with reference to Fig. 6, Fig. 7, and Fig. 8.

A memory 511 contains the motion-related transcoding hints metadata. A memory 512 contains the texture/edge related transcoding hints metadata, and a

memory 513 contains the feature point transcoding hints metadata, all of which will be described in detail below with reference to Fig. 15. A memory 514 contains video segment transcoding hints selection metadata, which will be described with reference to Fig. 16. The automatic extraction, compact representation, and usage of the transcoding hints metadata will now be described.

Fig. 6 discloses a video segmentation and transcoding hints state selection process in accordance with an embodiment of the invention. At step 601, some variables are initialized. The variable "frame" is the current frame number of the source bitstream, and "nframes" is the number of frames within the new video segment (or GOP, group of pictures). The other variables are only of use within this routine. At step 602, the number of frames within the GOP is incremented. At step 603, it is determined whether a new segment/GOP starts within the frame, details of which will be discussed in detail with reference to Fig. 7. If so ("yes"), control is passed to step 604, otherwise, it is passed to step 615. At step 604, the variable "last_gop_start" is initialized with the value of "new_gop_start". At steps 608 and 609, the variable "last_gop_stop" is set to "frame-1" if the variable "frame" is larger than 1. Otherwise, at step 610, "last_gop_stop" is set to 1. Next, at step 611, which is depicted in detail in Fig, 8, determines the transcoding hints state based on motion parameters 605, texture/edge parameters 606, and feature-point data 607. At step 612, the transcoding hints metadata are output to the transcoding hints metadata buffers. In accordance with an embodiment of the invention, the transcoding hints metadata comprises "nframes"

(number of frames within the GOP), the transcoding hints state with all the parameters, and the start frame number of the new GOP ("new_gop_start"). After that, the variable "nframes" is set to 0 and the current frame number "frame" is given to the variable "new_gop_start". Then, at step 615, it is tested to determine if all frames of the source bitstream have been processed. If not ("no"), control is passed to step 614 where the frame number is incremented and the process is repeated starting from step 602. Otherwise, the process is terminated.

Fig. 7 illustrates a method for determining the start frame and the end frame of a new video segment or GOP according to an embodiment of the invention. At step 701, it is determined whether the variable "nframes" from Fig. 6 is an integer multiple of M (which is the I/P frame distance). If so, then "no" is selected and at step 702, it is determined whether the current frame number is the first frame. If so ("no"), control is passed to step 703 where it is determined whether "nframes" is greater than a minimum number of frames "gop_min" within a GOP. In case the result at step 702 is "yes", a new GOP is started at step 705. In case the result at step 703 is "yes", a new GOP is started at step 705. In case the result at step 703 is "no", control is passed to step 704 where it is determined whether "nframes" is greater than a maximum number of frames "gop_max" within a GOP. In case the result at step 704 is "yes", the GOP is closed at step 706, otherwise, the process is terminated.

Fig. 8 illustrates a process for selecting a transcoding hint state for a specific GOP or A/V segment taking only the number of new feature points per frame into

account in accordance with an embodiment of the invention. Based on the basic idea illustrated, similar decision structures may be implemented using the aforementioned motion parameters from a parametric motion estimation as well as texture/edge parameters gained from DCT-coefficients. It is noted that the class or algorithms described may also be used to classify A/V material in terms of motion, edge activity, new content per frame, etc., leading to a higher level of A/V classification. In such cases, the transcoding hint states would represent specific classes of different content material. Referring now to Fig. 8, at step 801, variables "frame_no", "last_gop_start", "sum" and "new_seg" are initialized. The variable "frame no" is given the contents of the "last_gop_start" parameter, and the variables "sum" and "new_seg" are initialized with zero. Then, at step 802, the contents of the variable "sum" is incremented by the number of new feature points of the current frame ("frame_no"). At step 803, it is determined whether the variable "frame_no" is less than the variable "last_gop_stop". If so ("yes"), step 802 is repeated, otherwise, control is passed to step 804. At step 804, it is determined whether the value of the variable "sum" is less than one-eight of a predetermined parameter "summax". The parameter "summax" is a constant that represents the maximum number of feature points that can be tracked from frame to frame multiplied by the number of frames between the frames "last_gop_start" and "last_gop_stop". It may have the value 200 according to an embodiment of the invention. If the result at step 804 is "yes", the transcoding hints state 1 is selected at step 806 for which the parameters are shown in Table 1 of Fig. 8. Otherwise, at step

805, it is determined whether the value of the variable "sum" is less than one-quarter of the predetermined parameter "summax". If so ("yes"), the transcoding hints state 2, as shown in Table 1 is selected at step 807. If not ("no"), the transcoding hints state 3 (as shown in Table 1) is selected at step 808 and the process is terminated. It is noted that the decision thresholds in steps 804 and 805 depend on the definition and number of transcoding hints states.

Transcoding Hints Metadata Description

For metadata explanation, a pseudo C-code style may be used. Abbreviations D for Description and DS for Description Schemes, as defined in the emerging MPEG-7 metadata standard, may be used.

Fig. 9 depicts a structural organization of transcoding hints metadata within a Generic A/V DS 901 in accordance with an embodiment of the invention. As shown in Fig. 9, Segment DS 904 and Media Info DS 902 are derived from Generic A/V DS 901. Segment Decomposition 906 is derived from Segment DS 904, and Video Segment DS 907 and Moving Region DS 907 are derived from Segment Decomposition 906. Segment-based transcoding hints DS 909, which will be described in detail with reference to Fig. 14, is derived from Video Segment DS 907. Video Segment DS 907 accesses one or several transcoding hint state DS 911, which will be described in detail with reference to Fig. 16. From Moving Region DS 908, the Segment-based transcoding hints DS 910, which will be described in detail with reference to Fig. 14, for moving regions is derived, which accesses one or several transcoding hint state DS 912, which will be described in detail with reference to Fig.

16. From Media Info DS 902, Media Profile DS 903 is derived. From Media Profile DS 903, General Transcoding Hints DS 905, which will be described with reference to Figure 10, is derived.

Fig. 10 depicts the structural organization of Transcoding Hints DS 1001, which consists of one instance of the Source Format Definition DS 1002, which will be described with reference to Fig. 11, one or several instances of target format definition DS 1003 which will be described with reference to Fig. 12. Additionally, Transcoding Hints DS 1001 consists of one optional instance of General Transcoding Hints DS 1004, which will be described with reference to Fig. 13, and one optional Transcoding Encoding Complexity DS 1005, which will be described with reference to Fig. 15.

Fig. 11 depicts source format definition transcoding hints metadata (e.g., Source Format Definition DS 1002 in Fig. 10) which is associated to the whole A/V content or to a specific A/V segment, in accordance with an embodiment of the invention. As shown in Fig. 11, relevant Descriptors and Description Schemes may include:

- **bitrate** is of type <int> and describes the bit rate per second of the source A/V data stream.
- **size_of_pictures** is of type <2*int> and describes the size of picture of the source A/V format in x and y directions.
- **number_of_frames_per__second** is of type <int> and describes the number of frames per second of the source content.
- **pel_aspect_ratio** is of type <float> and describes the pel aspect ratio.

- **pel_colour_depth** is of type <int> and describes the color depth.
- **usage_of_progressive_interlaced_format** is of size < 1 bit> and describes whether the source format is in progressive or in interlaced format.
- **usage_of_frame_field_pictures** is of size <l bit> and describes whether frame or field pictures are used.
- **compression method** is of type <int> and defines the compression method used for the source format and may be selected from a list that includes: MPEG-1, MPEG-2, MPEG-4, DV, H.263, H,261, etc. For every compression method, further parameters may be defined here.
- **GOP_structure** is a run-length-encoded data field of the I,P,B-states. For example, in case there are only I-frames in an MPEG-2 video, direct conversion to the DV format in compressed domain is possible.

Fig. 12 depicts target format definition transcoding hints metadata, which may be associated to the whole A/V content or to a specific A/V segment, in accordance with an embodiment of the invention. As shown in Fig. 12, the relevant Descriptors and Description Schemes may include:

- **bitrate** is of type <int> and describes the bit rate per second of the target A/V data stream.
- **size_of_pictures** is of type <2*int> and describes the size of picture of the target A/V format in x and y directions.

- **number_of_frames_per_second** is of type <int> and describes the number of frames per second of the target content.
- **pel_aspect_ratio** is of type <float> and describes the pel aspect ratio.
- **pel_colour_depth** is of type <int> and describes the color depth.
- **usage_of_progressive_interiaced_format** is of size <1 bit> and describes whether the target format needs to be progressive or interlaced.
- **usage_of_frame_field_pictures** is of size <1 bit> and describes whether frame or field pictures are used.
- **compression_method** is of type <int> and defines the compression method used for the target format and may be selected from a list that includes: MPEG-1, MPEG-2, MPEG-4, DV, H.263, H.261, etc. For every compression method, further parameters may be defined here.
- **GOP_structure** is an optional run-length-encoded data field of the I,P,B-states. With this optional parameter, a fixed GOP structure may be forced. A Fixed GOP structure may be useful, for example, to force I-frames at certain locations to facilitate video editing.

Fig. 13 depicts general transcoding hints metadata (e.g., General Transcoding Hints DS 1004 in Fig. 11), which may be associated to the whole A/V content or to a specific A/V segment, according to an embodiment of the invention. As shown in Fig. 13, relevant Descriptors and Description Schemes may include:

- **use_region_of_interest_DS** has a length of <1 bit> and indicates whether

a region of interest description scheme is available as transcoding hints.

- In case the **region_of_interest_DS** is used, then a **shape_D** (which may be for example one of the following: **boundary_box_D, MB_shape_D,** or any other **shape_D**) together with a **motion_trajectory_D** may be used to spatially and temporally describe the region of interest. An **MB_shape_D** may use macroblock (16x16) sized blocks for object shape description. **Motion_trajectory_D** already includes a notion of time so that the start frame and the end frame of the **region_of_interest_DS** may be defined. The **region_of_interest_DS** may have the size of the respective **shape_D** and the respective **motion_trajectory_D**. For transcoding applications, the **region_of_interest_DS** may be used, for example, to spend more bits (or modify the quantizer, respectively) for the blocks within the region of interest than for the background. Another transcoding application to MPEG-4 may be to describe the region of interest by a separate MPEG-4 object and to spent a higher bit rate and a higher frame rate for the region of interest than for other MPEG-4 objects like the background. The extraction of the **region_of_interest_DS** may be performed automatically or manually.
- **use_editing_effects_transcoding_hints_DS** has a length of <1 bit> and indicates if information is available on editing-effects-based transcoding hints.

- **camera_flash** is a list of entries where every entry describes the frame number where a camera flash occurs. Therefore, the length of the descriptor is the number of camera flash events multiplied by <int>. For transcoding applications, the **camera_flash** descriptor is very useful, as most of the video (re-) encoders /transcoders use a motion estimation method based on the luminance difference, c.f. Peter Kuhn: "Algorithms, Complexity Analysis and VLSI Architectures for MPEG-4 motion estimation", Kluwer Academic Publishers, 1999. In case of a luminance-based motion estimation, the mean absolute error between two macroblocks of two subsequent frames (one with flash, one without flash) would be too high for prediction and the frame with the camera flash would have to be encoded as Intra-frame with high bit rate costs. Therefore, indicating the camera flash within a transcoding hints Description Scheme ("DS"), allows for using, for example, a luminance corrected motion estimation method or other means to predict the frame with the camera flash from the anchor frame(s) with moderate bit costs.
- **cross_fading** is a list of entries where every entry describes the start frame and the end frame of a cross fading. Therefore, the length of this descriptor is two times <int> of the number of cross fading events. Indicating the cross fading events in transcoding hints metadata is very useful for controlling the bit rate/quantizer during the cross fading.

During cross fading, prediction is generally of limited use causing a bit rate increase for prediction error coding. As during cross fading, the scene is usually blurred, the bit rate increase may be limited by adjusting the quantizer scale, bit rate, or rate control parameters, respectively.

- **black_pictures** is a list of entries where every entry describes the start frame and the end frame of a sequence of black pictures. Between scenes, especially in home video, black pictures may occur. Experimentally, results indicate that a series of black pictures increases the bit rate in motion-compensated DCT coders because the prediction is only of limited use. Therefore, this transcoding hints descriptor may be used to limit the bit rate during black pictures by adjusting the quantizer scale, bit rate, or rate control parameters, respectively.
- **fade_in** is similar to **cross_fading**, and is described as a number of entries determining the start frame and the end frame of a fade in. In comparison to cross fading, the fade in starts from black pictures, and, therefore, a kind of masking effect of the eye may be used to limit the bit rate during fade in by adjusting the quantizer_scale, bit rate, or rate control parameters, respectively.
- **fade_out** is similar to **fade_in**, except that after a scene, a series of black pictures are described.
- **abrupt_change** is described by a list of single frame numbers of type

<int> indicating where abrupt scene or shot changes without fading appear. These events are indicated, for example, by the very high and sharp peaks in Fig. 3. These peaks indicate the beginning of a new camera shot or scene. The abrupt_change editing effect is in contrast to the fading effects. When abrupt changes between two video segments appear, then the human visual perception needs a few milliseconds to adapt and recognize the details of the new A/V segment. This slowness effect of the human eye may be used beneficially for video transcoding, for example, for reducing the bit rate or modifying the quantizer scale parameters for the first frames of a video segment after an abrupt change of a scene or shot.

- **use_motion_transcoding_hints_DS** has a length of <1 bit> and indicates the use of motion-related transcoding hints metadata.
- **number of regions** indicates the number of regions for which the following motion-related transcoding hints metadata are valid.
- **for_every_region** is indicated by a field of < 1 bit> length, whether the region is rectangular or arbitrarily-shaped. In case the region is arbitrarily-shaped, a region descriptor (consisting, e.g., of a shape descriptor and a motion trajectory descriptor) is used. In case of a rectangular region, the size of the rectangular region is used. The motion field within this region is described by a parametric motion model, which

is determined by several parameters for every frame or sequence of frames. For transcoding, this motion representation of the real motion of the source video may be used to limit the search area of the computational complex motion estimation of the (re-)encoding part, and also for fast and efficient interlaced/de-interlaced (frame/field) conversion and determining the GOP (Group of Pictures) structure depending on the amount of motion within the video. The motion representation may also be used beneficially for size conversion of the video.

Fig. 14 depicts the segment-based transcoding hints metadata (e.g., segment-based transcoding hints DS 909 and 910 in Fig. 9) which may be used to determine the (re-) encoder/transcoder settings for an A/V segment which depicts constant characteristics, in accordance with an embodiment of the invention. As shown in Fig. 14, relevant Descriptors and Description Schemes may include:

- **start_frame** is of type <int> and describes the frame number of the beginning of the transcoding hints metadata of an A/V segment.
- **nframes** is of type <int> and describes the length of an A/V segment.
- **I_frame_location** gives several possibilities for describing the location of I-frames within an A/V segment.
- **select_one_out_of_the_following** is of size <2 bit> and selects one of the following four I-frame location description methods.

- **first frame** is of size <1 bit> and is the default I-frame location. This method describes an A/V segment where only the first frame is an Intra frame of the A/V segment and is used as an anchor for further prediction and all other frames within the A/V segment are P- or B-frames.
- **List of frames** gives a list of frame numbers of Intra-frames within an A/V segment. This method allows for arbitrarily describing the location of Intra-frames within an A/V segment. For k frames within this list, the size of this descriptor is < k*int >.
- **first_frame_and_every_k_frames** is of type <int>, where the first frame within a segment is Intra and k describes the interval of I-frames within the A/V segment.
- **no_I_frame** is of size < 1 bit> and describes the case where no I-frame is used within an A/V segment, which is useful when the encoding of the A/V segment is based on an anchor (Intra-frame) in a previous segment.
- **quantizer_scale** is of type <int> and describes the initial quantizer scale value for an A/V segment.
- **target_bitrate** is of type <int> and describes the target bit rate per second for an A/V segment.
- **target_min_bitrate** is of size <int> and describes the minimum target bit rate per second for an A/V segment (optional).
- **target_max_bitrate** is of size <int> and describes the maximum target

bit rate per second for an A/V segment (optional).

- **use_transcoding_states** is of size <1 bit> and describes whether transcoding hint states are used for an A/V segment.
- **transcoding_state_nr** is of type <int> and gives the transcoding hint metadata state for a segment. The transcoding hint metadata state is a pointer to an entry in a table of transcoding hint states. The table of transcoding hint states may have several entries, where new entries may be added or deleted by transcoding hints parameters. The transcoding hints metadata of a single transcoding hint state will be described with reference to Fig. 16.
- **add_new_transcoding_state** is of size <l bit> and describes whether a new transcoding state with associated information has to be added to the transcoding hints table. In case the add_new_transcoding_state signals "yes", a list of parameters of the new transcoding hints state is given. The size of the parameter list is determined by the number of parameters of one transcoding hints state and the number of transcoding hints state.
- **remove_transcoding_state** is a flag of size <l bit> indicating whether a transcoding state may be removed or not. In case a transcoding state may be removed, the state number (type: <int>) of the transcoding state to be removed is given.
- **use_encoding_complexity_description** is of size < 1 bit> and signals whether a more detailed encoding complexity description scheme as

defined in Fig. 15 has to be used.

Fig. 15 depicts the coding complexity transcoding hints metadata, which may be associated to the whole A/V content or to a specific A/V segment, according to an embodiment of the invention. Encoding complexity metadata may be used for rate control and determines the quantizer and bit rate settings.

- **use_feature_points** is of size <1 bit> and indicates the use of feature point based complexity estimation data.
- **select_feature_point_method** is of size <2 bits> and selects the feature point method.
- **number_of_new_feature_points** per frame describes a list of the number of new feature points per frame as indicated in Fig. 3, and which are of size <nframes * int>. This metric indicates the amount of new content per frame.
- **feature_point_metrics** describes a list of metrics based on the new feature points per frame within one segment. The metrics are represented as an ordered list of <int> values with the following meaning: mean, max, min, variance, standard deviation of the number of the new feature points per frame.
- **use_equation_description** is an <int> pointer to an equation-based description of the encoding complexity per frame.
- **use_motion_description** is of size <1 bit> and indicates the use of a

motion-based complexity description.

- **select_motion_method** is of size <4 bits> and selects the motion description method.
- **param_k_motion** is of size <nframes * k * int> and describes the k parameters for every single frame of a global parametric motion model.
- **motion_metrics** describes a list of metrics for the whole segment-based on the size of the motion vectors. The metrics are represented as an ordered list of <int> values with the following meaning: mean, max, min, var, stddev of the macroblock motion vectors.
- **block_motion_field** describes every vector of an m*m block sized motion field and is of size < nframes*int*size_x*size_y / (m*m)>.
- **use _texture_edge_metrics** is a flag that is set when texture or edge metrics are used and it is of size <1 bit>.
- **select_texture_edge_metrics** is of size <4 bits> and it determines which texture metric from the following is used.
- **DCT_block_energy** is the sum of all DCT-coefficients of one block and is defined for every block within a frame. It is of size <size_y*size-X*nframes*int/64>.
- **DCT_block_activity** is defined as the sum of all DCT-coefficients of one block but without the DC coefficient. It is defined for every block within a frame and is of size <size_y*size_x*nframes*int/64>

- **DCT_energy_metric** describes a list of metrics for the whole segment-based on the individual DCT energies of each block. The metrics are represented as an ordered list of <int> values with the following meaning: mean, max, min, variance, standard deviation of all the individual DCT energy metrics. The size of the descriptor is <6*int>. An alternative implementation of this descriptor is to describe the DCT energy metric for every single frame of the video segment.
- **DCT_activity_metric** describes a list of metrics for the whole segment-based on the individual DCT activities of each block. The metrics are represented as an ordered list of <int> values with the following meaning: mean, max, min, variance, standard deviation of all the individual DCT activity metrics. The size of the descriptor is <6*int>. An alternative implementation of this descriptor is to describe the DCT activity metric for every single frame of the video segment.

Fig. 16 depicts the transcoding hints state metadata, which may be associated to the whole audio-visual content or to a specific A/V segment according to an embodiment of the invention. Relevant Descriptors and Description Schemes may include:

- **M** is of type <int> and describes the I-frame/P-frame distance.
- **bitrate_fraction_for_I** is of type <float> and describes the fraction of the bit rate defined for an A/V segment that is available for I frames.

- **bitrate_fraction_for P** is of type <float> and describes the fraction of the bit rate defined for an A/V segment that may be used for P frames. The bit rate fraction for B-frames is the rest of the percentage to 100 %.
- **quantizer_scale_ratio_I_P** is of type <float> and denotes the relation of the quantizer scale (as defined for this segment) between I- and P-frames.
- **quantizer_scale_ratio_I_B** is of type <float> and denotes the relation of the quantizer scale (as defined for this segment) between I- and B-frames. It is noted that either the bit rate descriptors (bitrate_fraction_for_I<bitrate_fraction_for_P), the quantizer_scale_ratio descriptors (quantizer_scale_ratio_I_P, quantizer_scale_ratio_I_B) or the following rate-control parameters may be mandatory.
- **X_I, X_P, X _B** are frame_vbv_complexities and are each of type <int> and are defined in case of frame based compression target format (cf., Fig. 12). These and the following Virtual Buffer Verifier ("VBV") complexity adjustments may be optional and may be used to modify the rate control scheme according to the source content characteristics and the target format definition.
- **X_I top, X_P top, X B top** are field_vbv_complexities for the top field and are each of type <int> and are defined in case of field based compression target format (cf. Fig. 12).

- **X_I_bot, X_P_bot, X_B_bot** are field_vbv_complexities for the bottom field and are each of type <int> and are defined in case of field based compression target format (cf. Fig. 12).

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, because certain changes may be made in carrying out the above method and in the construction(s) set forth without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therein.

Claims

1. A video/audio signal processing method for processing supplied video/audio signals, comprising the steps of:

describing transcoding target bitstream parameters;

extracting transcoding hints metadata;

storing the transcoding hints metadata;

separating A/V material into segments;

associating the transcoding hints metadata to the separated A/V segments; and

transcoding the A/V material.

2. A video/audio signal processing method according to claim 1, wherein the step of describing the transcoding target bitstream parameters comprises the steps of:

defining a bit rate of a second bitstream of compressed images;

defining a size of pictures of the second bitstream of compressed images;

defining a number of frames per second of the second bitstream of compressed images;

defining an aspect ratio of a pel of the second bitstream of compressed images;

defining a color depth of each of the pel of the second bitstream of compressed images;

defining whether progressive format is used for the second bitstream of compressed images;

defining whether interlaced format is used for the second bitstream of

compressed images;

defining whether frame pictures are used for the second bitstream of compressed images;

defining whether hold pictures are used for the second bitstream of compressed images; and

defining a compression method of the second bitstream of compressed images.

3. A video/audio signal processing method according to claim 2, wherein the step of describing the transcoding target bitstream parameters further comprises the step of defining employed compression standards as defined by MPEG (Moving Pictures Expert Group).

4. A video/audio signal processing method according to claim 2, wherein the step of describing the transcoding target bitstream parameters further comprises the step of defining employed compression standards as defined by ITU-T (International Telecommunications Union Technical Standards Group).

5. A video/audio signal processing method according to claim 1, wherein the step of extracting the transcoding hints metadata comprises the steps of:

receiving a first bitstream of compressed image data having a first GOP structure;

obtaining first motion information from the first bitstream;

obtaining texture/edge information of a first segmentation;

obtaining feature points and associated motion information from the first bitstream; and

obtaining region of interest information from the first bitstream.

6. A video/audio signal processing method according to claim 5, wherein the step of extracting the transcoding hints metadata further comprises the step of storing the first motion information as transcoding hints metadata.

7. A video/audio signal processing method according to claim 5, wherein the step of extracting the transcoding hints metadata further comprises the step of representing motion-related transcoding hints metadata as parameters of a parametric motion model.

8. A video/audio signal processing method according to claim 7, wherein the step of extracting the transcoding hints metadata further comprises the step of employing the parametric motion model to describe a global motion within subsequent rectangular video frames.

9. A video/audio signal processing method according to claim 7, wherein the step of extracting the transcoding hints metadata further comprises the step of employing the parametric motion model to describe a motion within a defined region of arbitrary shape.

10. A video/audio signal processing method according to claim 9, wherein the parametric motion model is employed to describe the motion within the defined region of arbitrary shape as used within MPEG-4.

11. A video/audio signal processing method according to claim 5, wherein the step of extracting the transcoding hints metadata further comprises the step of representing motion-related transcoding hints metadata as an array of motion vectors contained in

the first bitstream of the compressed image data.

12. A video/audio signal processing method according to claim 5, wherein the step of extracting the transcoding hints metadata further comprises the step of representing motion-related transcoding hints metadata as an array of motion vectors derived from motion vectors contained in the first bitstream of the compressed image data.

13. A video/audio signal processing method according to claim 5, wherein the step of extracting the transcoding hints metadata further comprises the step of representing motion-related transcoding hints metadata as a list of feature points with associated motion vectors, which are tracked within subsequent frames.

14. A video/audio signal processing method according to claim 5, wherein the step of extracting the transcoding hints metadata further comprises the step of representing motion-related transcoding hints metadata as a list of feature points with associated motion vectors, which are tracked within arbitrarily shaped regions, within subsequent frames.

15. A video/audio signal processing method according to claim 5, wherein the step of extracting the transcoding hints metadata further comprises the step of representing texture-related transcoding hints metadata as one of a list of DCT-coefficients and a measure (one of mean, minimum, maximum, variance, and standard deviation) derived thereof.

16. A video/audio signal processing method according to claim 5, wherein the step of extracting the transcoding hints metadata further comprises the step of representing

edge-related transcoding hints metadata as one of a list of DCT-coefficients and a measure (one of mean, minimum, maximum, variance, and standard deviation) derived thereof.

17. A video/audio signal processing method according to claim 5, wherein the step of extracting the transcoding hints metadata further comprises the step of representing the feature points and associated motion-related transcoding hints metadata as a list.

18. A video/audio signal processing method according to claim 5, wherein the step of extracting the transcoding hints metadata further comprises the step of representing encoding-complexity-related transcoding hints metadata as a complexity metric derived from a life-time list of feature points tracked within subsequent frames by using a number of lost and new featurepoints from one frame to a next frame.

19. A video/audio signal processing method according to claim 1, wherein the step of storing the transcoding hints metadata comprises the step of maintaining a buffer containing transcoding hints metadata for several situations.

20. A video/audio signal processing method according to claim 19, wherein the step of storing the transcoding hints metadata further comprises the step of storing individual general transcoding hints metadata for several target devices.

21. A video/audio signal processing method according to claim 19, wherein the step of storing the transcoding hints metadata further comprises the step of storing general transcoding hints metadata for A/V segments of varying scene activity.

22. A video/audio signal processing method according to claim 1, wherein the step

of separating the A/V material into segments comprises the steps of:

using feature points with associated motion vectors;

tracking the feature points and keeping a life-time of feature points; and

determining a new A/V segment for transcoding based on a number of feature points that could not be tracked from one frame to a next frame.

23. A video/audio signal processing method according to claim 1, wherein the step of associating the transcoding hints metadata to the separated A/V segments comprises the steps of:

calculating a number of new feature points per frame;

determining if the number of new feature points exceeds some thresholds; and selecting based on said determination one of several transcoding hints states.

24. A video/audio signal processing method according to claim 1, wherein the step of transcoding the A/V material comprises the steps of:

receiving a first bitstream of compressed image data having a first GOP structure;

extracting transcoding hints metadata from the first bitstream;

utilizing the transcoding hints metadata associated to the first bitstream to facilitate transcoding; and

outputting a second bitstream.

25. A video/audio signal processing method according to claim 24, wherein the step of transcoding the A/V material further comprises the step of utilizing the transcoding

hints metadata associated to temporal segments of the first bitstream to facilitate transcoding.

26. A video/audio signal processing method according to claim 24, wherein the step of transcoding the A/V material further comprises the step of utilizing the transcoding hints metadata associated to spatial segments of the first bitstream to facilitate transcoding.

27. A video/audio signal processing method according to claim 24, wherein the step of transcoding the A/V material further comprises the step of utilizing motion information contained in the transcoding hints metadata to extrapolate second motion information for the second bitstream of compressed image data having a second GOP structure different from the first GOP structure.

28. A video/audio signal processing method according to claim 24, wherein the step of transcoding the A/V material further comprises the step of controlling a bit rate of the second bitstream so that a bit rate of the first bitstream is different from the bit rate of the second bitstream.

29. A video/audio signal processing method according to claim 28, wherein the step of transcoding the A/V material further comprises the step of adjusting a size of pictures represented by the first bitstream so that pictures represented by the second bitstream exhibits a size different from the size of the pictures represented by the first bitstream.

30. A video/audio signal processing method according to claim 24, wherein the step

of transcoding the A/V material further comprises the step of adjusting a size of pictures represented by the first bitstream so that pictures represented by the second bitstream exhibit a size different from the size of the pictures represented by the first bitstream.

31. A video/audio signal processing method according to claim 30, wherein the step of transcoding the A/V material further comprises the step of encoding the pictures represented by the second bitstream as field pictures when the pictures represented by the first bitstream are encoded as frame pictures.

32. A video/audio signal processing method according to claim 30, wherein the step of transcoding the A/V material further comprises the step of encoding the pictures represented by the second bitstream as frame pictures when the pictures represented by the first bitstream are encoded as field pictures.

33. A video/audio signal processing method according to claim 30, wherein the step of transcoding the A/V material further comprises the step of interlacing the pictures represented by the first bitstream when the pictures represented by the first bitstream are received as a progressive sequence so that the pictures represented by the second bitstream are output as an interlaced sequence.

34. A video/audio signal processing method according to claim 30, wherein the step of transcoding the A/V material further comprises the step of de-interlacing the pictures represented by the first bitstream when the pictures represented by the first bitstream are received as an interlaced sequence so that pictures represented by the second

bitstream are output as a progressive sequence.

35. A video/audio signal processing method according to claim 24, wherein the step of transcoding the A/V material further comprises the step of encoding pictures represented by the second bitstream as field pictures when pictures represented by the first bitstream are encoded as frame pictures.

36. A video/audio signal processing method according to claim 24, wherein the step of transcoding the A/V material further comprises the step of encoding pictures represented by the second bitstream as frame pictures when pictures represented by the first bitstream are encoded as field pictures

37. A video/audio signal processing method according to claim 24, wherein the step of transcoding the A/V material further comprises the step of interlacing pictures represented by the first bitstream when pictures represented by the first bitstream are received as a progressive sequence so that pictures represented by the second bitstream are output as an interlaced sequence.

38. A video/audio signal processing method according to claim 24, wherein the step of transcoding the A/V material further comprises the step of de-interlacing pictures represented by the first bitstream when pictures represented by the first bitstream are received as an interlaced sequence so that pictures represented by the second bitstream are output as a progressive sequence.

39. A transcoding method, comprising the steps of:

receiving a first bitstream of compressed image data representing pictures of a

first size;

extracting first motion-related transcoding hints metadata from the first bitstream;

storing the first motion-related transcoding hints metadata;

utilizing the stored first motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data representing pictures of a second size different from the first size; and

outputting the second bitstream.

40. A transcoding method, comprising the steps of:

receiving a first bitstream of compressed image data representing pictures defining an interlaced sequence;

extracting first motion-related transcoding hints metadata from the first bitstream;

storing the first motion-related transcoding hints metadata;

utilizing the stored first motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data representing pictures defining a progressive sequence; and

outputting the second bitstream.

41. A transcoding method, comprising the steps of:

receiving a first bitstream of compressed image data representing pictures defining a progressive sequence;

extracting first motion-related transcoding hints metadata from the first bitstream;

storing the first motion-related transcoding hints metadata;

utilizing the stored first motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data representing pictures defining an interlaced sequence; and

outputting the second bitstream.

42. A transcoding method, comprising the steps of:

receiving a first bitstream of compressed image data representing frame pictures;

extracting first motion-related transcoding hints metadata from the first bitstream;

storing the first motion-related transcoding hints metadata;

utilizing the stored first motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data representing field pictures; and

outputting the second bitstream.

43. A transcoding method, comprising the steps of:

receiving a first bitstream of compressed image data representing field pictures;

extracting first motion-related transcoding hints metadata from the first bitstream;

storing the first motion-related transcoding hints metadata;

utilizing the stored first motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data representing frame pictures; and

outputting the second bitstream.

44. A transcoding method, comprising the steps of;

receiving a first bitstream of compressed image data representing a main image;

extracting first motion-related transcoding hints metadata from the first bitstream;

storing the first motion-related transcoding hints metadata;

utilizing the stored first motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data representing a portion of the main image; and

outputting the second bitstream.

45. A transcoding method, comprising the steps of:

receiving a first bitstream of compressed image data having a plurality of coding parameters including at least one of a GOP structure, a picture size, a bit rate, a frame picture format, a field picture format, a progressive sequence, and an interlaced sequence;

extracting first motion-related transcoding hints metadata from the first bitstream;

storing the first motion-related transcoding hints metadata;

utilizing the stored first motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data having a plurality of coding parameters such that one or more of the coding parameters of the second bitstream are different from the coding parameters of the first bitstream; and outputting the second bitstream.

46. A transcoding method comprising the steps of:

receiving a first bitstream of compressed image data representing pictures of a first size;

extracting first feature point motion-related transcoding hints metadata from the first bitstream;

storing the first feature point motion-related transcoding hints metadata;

utilizing the stored first feature point motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data representing pictures of a second size different from the first size; and

outputting the second bitstream.

47. A transcoding method, comprising the steps of:

receiving a first bitstream of compressed image data representing pictures defining an interlaced sequence;

extracting first feature point motion-related transcoding hints metadata from the first bitstream;

storing the first feature point motion-related transcoding hints metadata;

utilizing the stored first feature point motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data representing pictures defining a progressive sequence; and

outputting the second bitstream.

48. A transcoding method, comprising the steps of:

receiving a first bitstream of compressed image data representing pictures defining a progressive sequence;

extracting first feature point motion-related transcoding hints metadata from the first bitstream;

storing the first feature point motion-related transcoding hints metadata;

utilizing the stored first feature point motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data representing pictures defining an interlaced sequence; and

outputting the second bitstream;

49. A transcoding method, comprising the steps of:

receiving a first bitstream of compressed image data representing frame pictures;

extracting first feature point motion-related transcoding hints metadata from the first bitstream;

storing the first feature point motion-related transcoding hints metadata;

utilizing the stored first feature point motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image

data representing field pictures; and

outputting the second bitstream.

50. A transcoding method, comprising the steps of:

receiving a first bitstream of compressed image data representing field pictures;

extracting first feature point motion-related transcoding hints metadata from the first bitstream;

storing the first feature point motion-related transcoding hints metadata;

utilizing the stored first feature point motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data representing frame pictures; and

outputting the second bitstream.

51. A transcoding method, comprising the steps of:

receiving a first bitstream of compressed image data representing a main image; extracting first feature point motion-related transcoding hints metadata from the first bitstream;

storing the first feature point motion-related transcoding hints metadata;

utilizing the stored first feature point motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data representing a portion of the main image; and

outputting the second bitstream.

52. A transcoding method, comprising the steps of:

receiving a first bitstream of compressed image data having a plurality of coding parameters including at least one of a GOP structure, a picture size, a bit rate, a frame picture format, a field picture format, a progressive sequence, and an interlaced sequence;

extracting first feature point motion-related transcoding hints metadata from the first bitstream;

storing the first feature point motion-related transcoding hints metadata;

utilizing the stored first feature point motion-related transcoding hints metadata to extrapolate second motion information for a second bitstream of compressed image data having a plurality of coding parameters such that one or more of the coding parameters of the second bitstream are different from the coding parameters of the first bitstream; and

outputting the second bitstream.

53. A video processing method for processing supplied video signals, comprising the steps of:

receiving a source video; and

classifying contents of the source video using one of motion metadata, texture/edge metadata, and feature points and associated motion metadata, including a number of new feature points per frame.

54. A video processing method according to claim 53, wherein said method is used for determining transcoding parameters settings of a transcode.

55. A video processing method according to claim 53, wherein said method is used for organizing audiovisual material based on the classification of the contents of the source video.

56. An apparatus for processing supplied video/audio signals, comprising:

a target buffer for storing at least one description of transcoding target bitstream parameters;

an extraction unit for extracting transcoding hints metadata based on the at least one description;

a buffer for storing the transcoding hints metadata;

a segmenting unit for separating A/V material into segments; and

a transcoding unit for associating the transcoding hints metadata to the separated A/V segments and transcoding the A/V material.

57. A transcoding apparatus, comprising:

an input for receiving a first bitstream of compressed image data representing pictures of a first size;

a transcoding hints metadata extraction unit for extracting transcoding hints metadata from the first bitstream;

a buffer for storing the transcoding hints metadata;

a processing unit for utilizing the stored transcoding hints metadata to extrapolate motion information for a second bitstream of compressed image data different from the first bitstream; and

an output for outputting the second bitstream.

58. An apparatus for processing supplied video signals, comprising:

an input for receiving a source video; and

a processor for classifying contents of the source video using one of motion metadata, texture/edge metadata, and feature points and associated motion metadata, including a number of new feature points per frame.

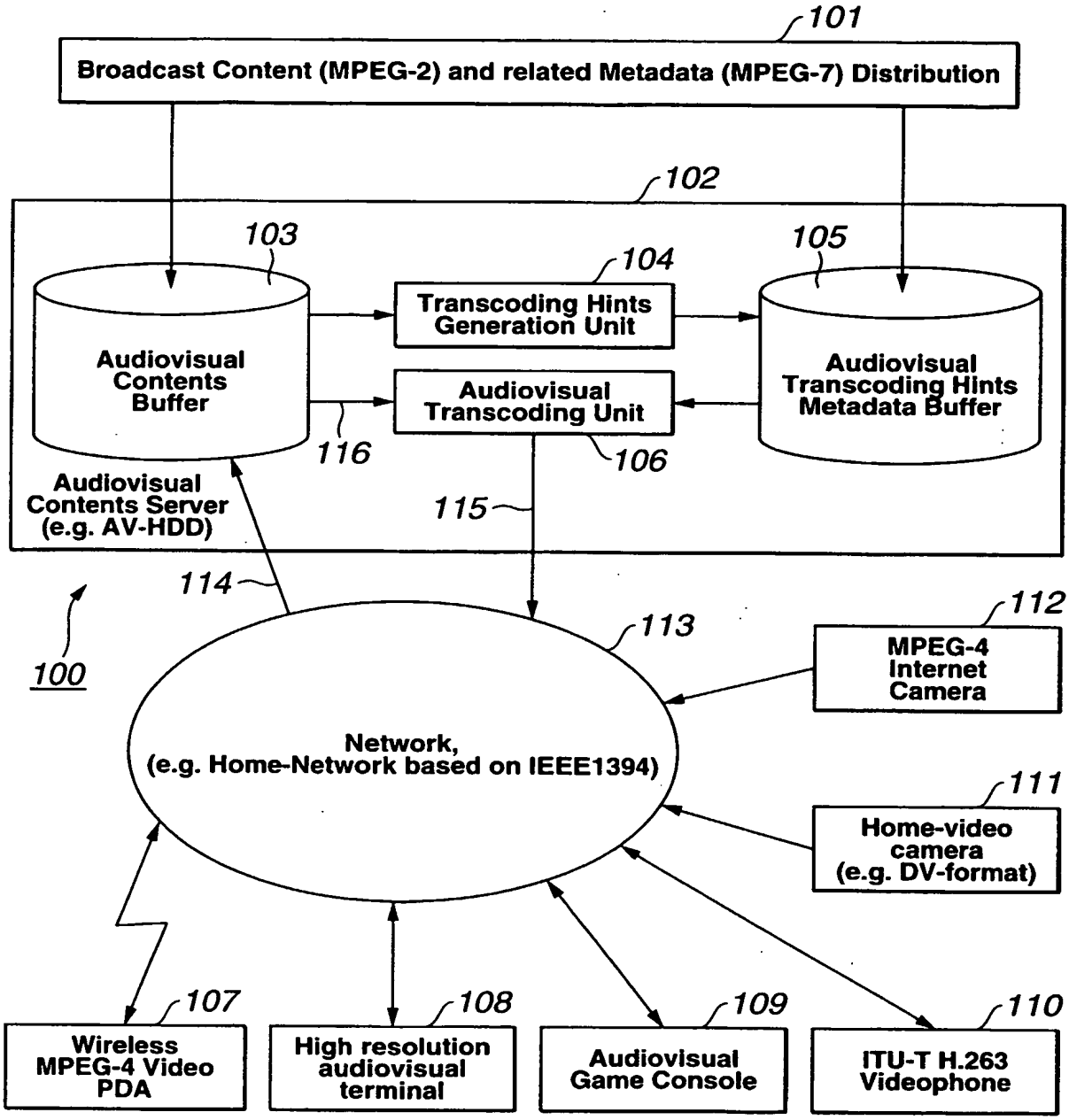

101
Broadcast Content (MPEG-2) and related Metadata (MPEG-7) Distribution
102
103
Audiovisual Contents Buffer
104
Transcoding Hints Generation Unit
105
Audiovisual Transcoding Hints Metadata Buffer
Audiovisual Transcoding Unit
116
106
Audiovisual Contents Server (e.g. AV-HDD)
115
114
100
113
112
MPEG-4 Internet Camera
Network, (e.g. Home-Network based on IEEE1394)
111
Home-video camera (e.g. DV-format)
107
Wireless MPEG-4 Video PDA
108
High resolution audiovisual terminal
109
Audiovisual Game Console
110
ITU-T H.263 Videophone

FIG.1

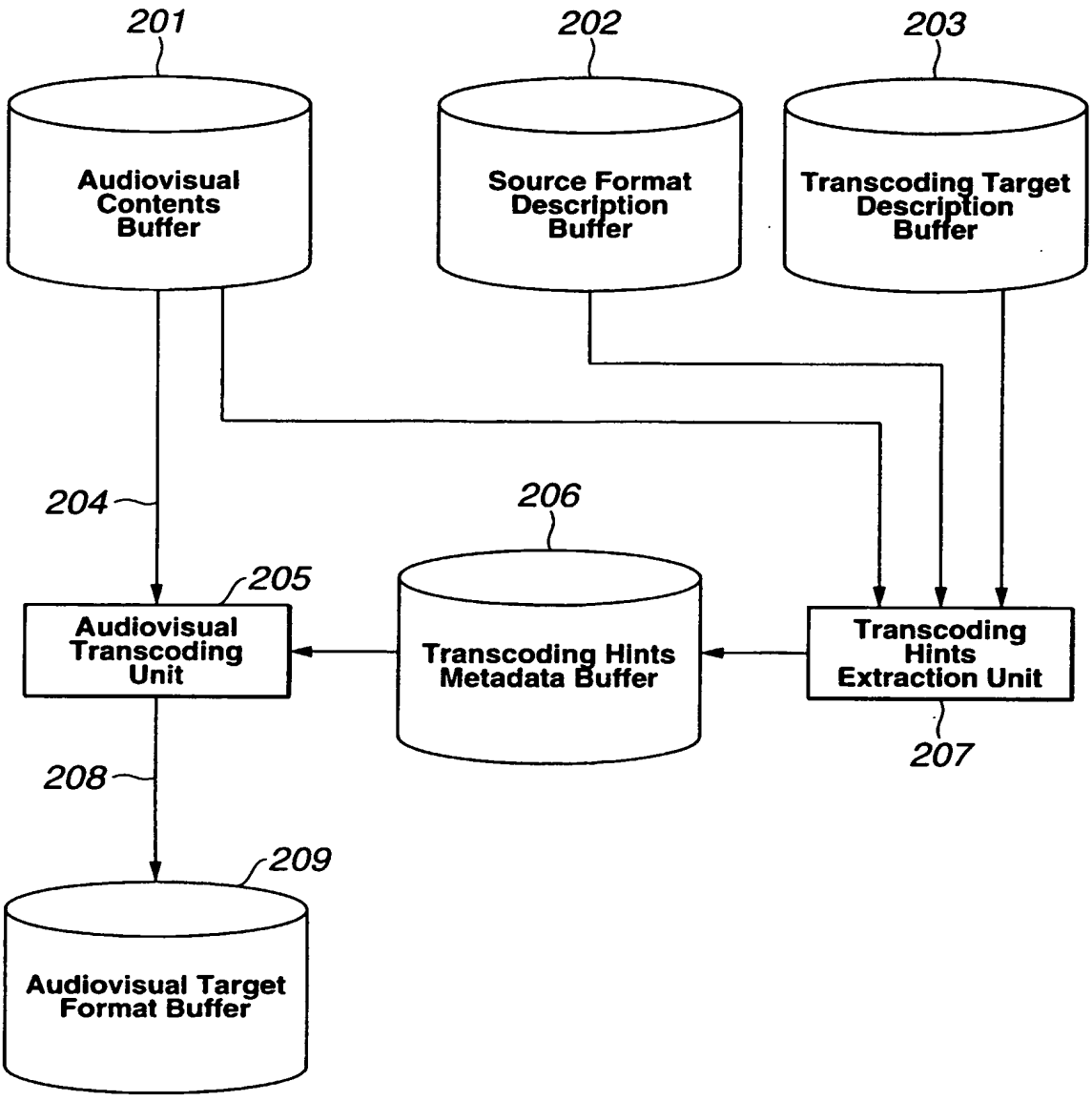

201
202
203
Audiovisual Contents Buffer
Source Format Description Buffer
Transcoding Target Description Buffer
204
206
205
Audiovisual Transcoding Unit
Transcoding Hints Metadata Buffer
Transcoding Hints Extraction Unit
207
208
209
Audiovisual Target Format Buffer

FIG.2

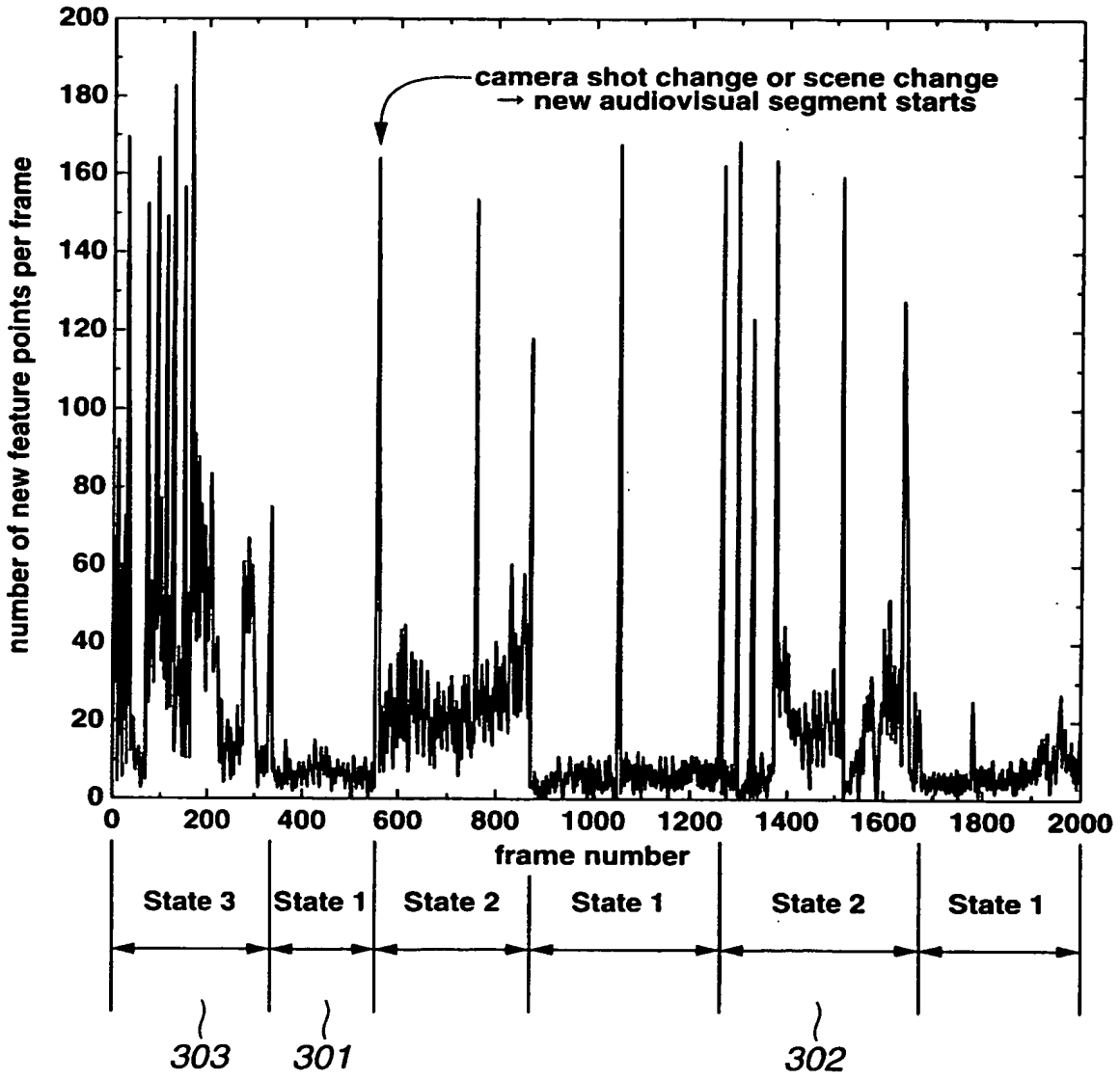

camera shot change or scene change
→ new audiovisual segment starts
number of new feature points per frame
0
20
40
60
80
100
120
140
160
180
200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
frame number
State 3
State 1
State 2
State 1
State 2
State 1
303
301
302

FIG.3

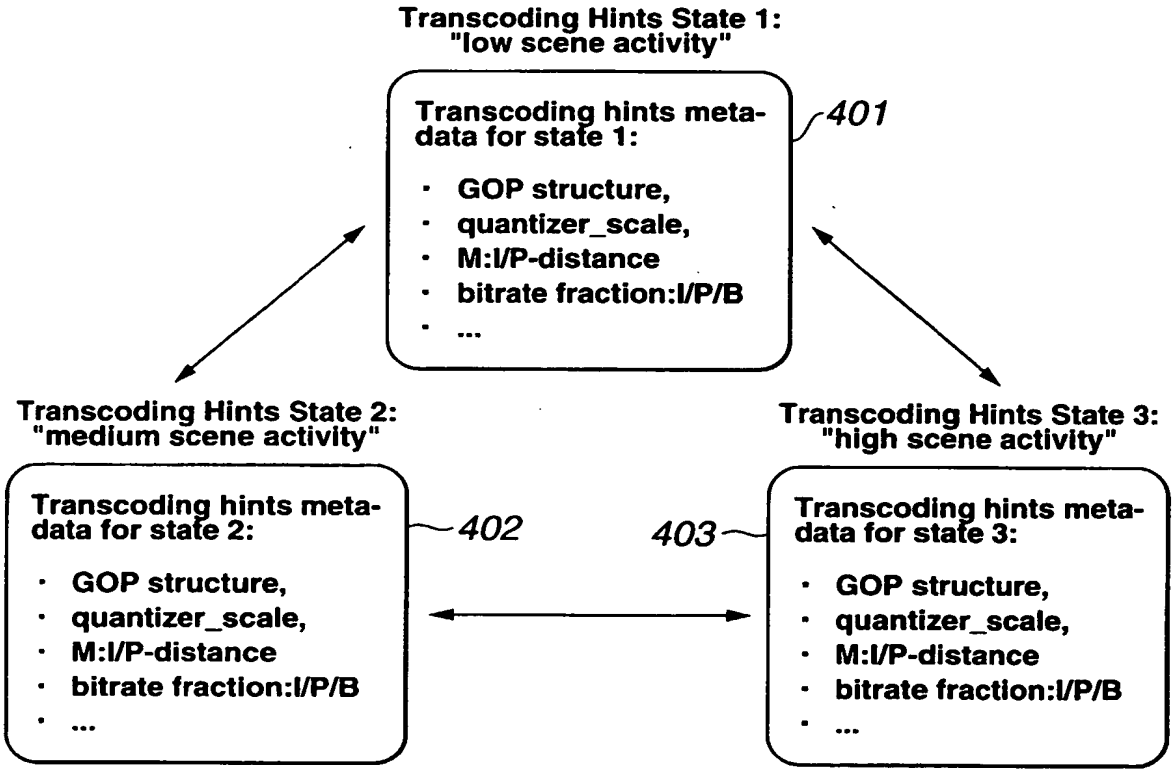

Transcoding Hints State 1:
"low scene activity"
Transcoding hints meta-data for state 1:
GOP structure,
quantizer_scale,
M:I/P-distance
bitrate fraction:I/P/B
...
401
Transcoding Hints State 2:
"medium scene activity"
Transcoding hints meta-data for state 2:
GOP structure,
quantizer_scale,
M:I/P-distance
bitrate fraction:I/P/B
...
402
Transcoding Hints State 3:
"high scene activity"
403
Transcoding hints meta-data for state 3:
GOP structure,
quantizer_scale,
M:I/P-distance
bitrate fraction:I/P/B
...

FIG.4

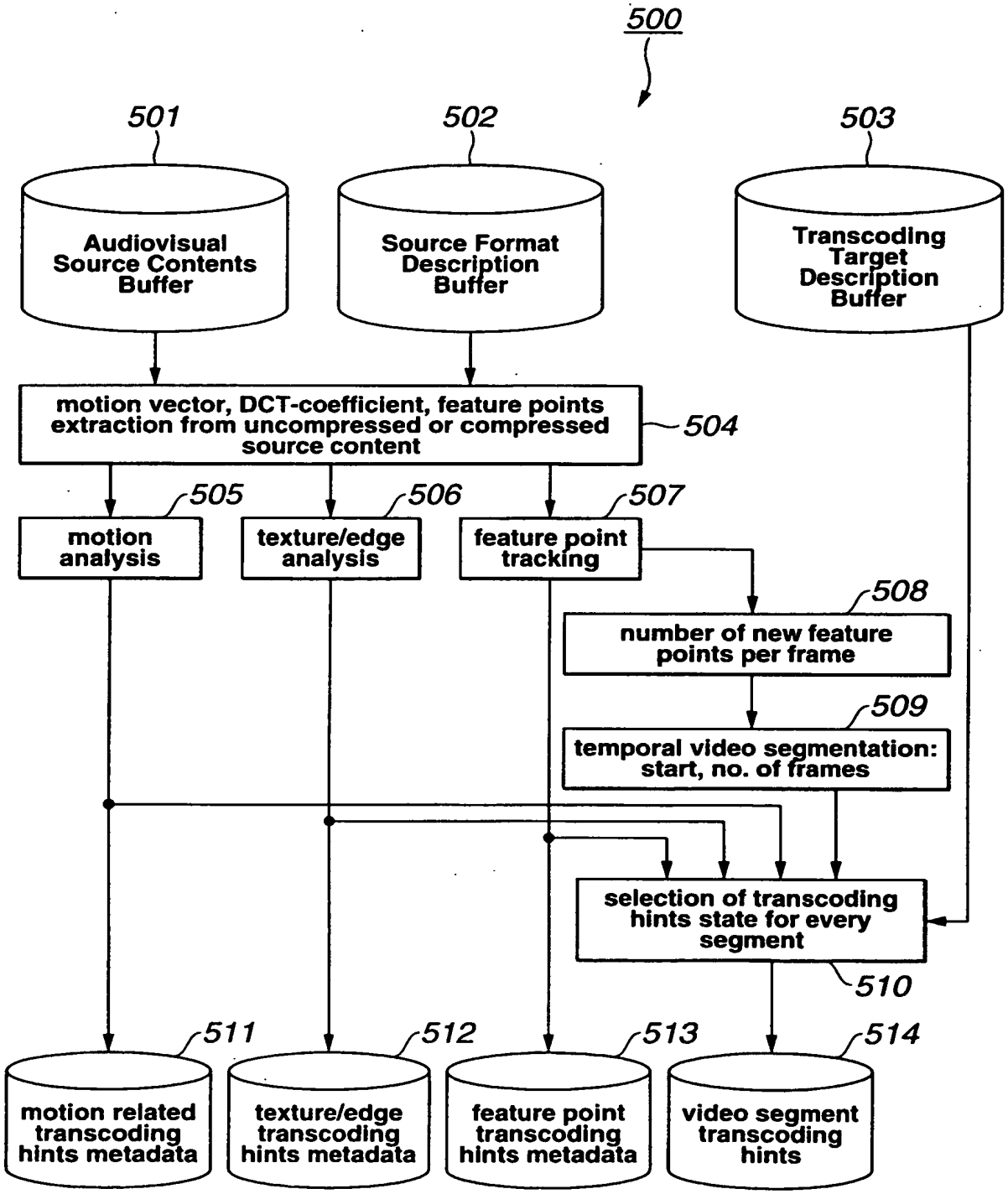

500
501
502
503
Audiovisual Source Contents Buffer
Source Format Description Buffer
Transcoding Target Description Buffer
motion vector, DCT-coefficient, feature points extraction from uncompressed or compressed source content
504
505
506
507
motion analysis
texture/edge analysis
feature point tracking
508
number of new feature points per frame
509
temporal video segmentation: start, no. of frames
selection of transcoding hints state for every segment
510
511
512
513
514
motion related transcoding hints metadata
texture/edge transcoding hints metadata
feature point transcoding hints metadata
video segment transcoding hints

FIG.5

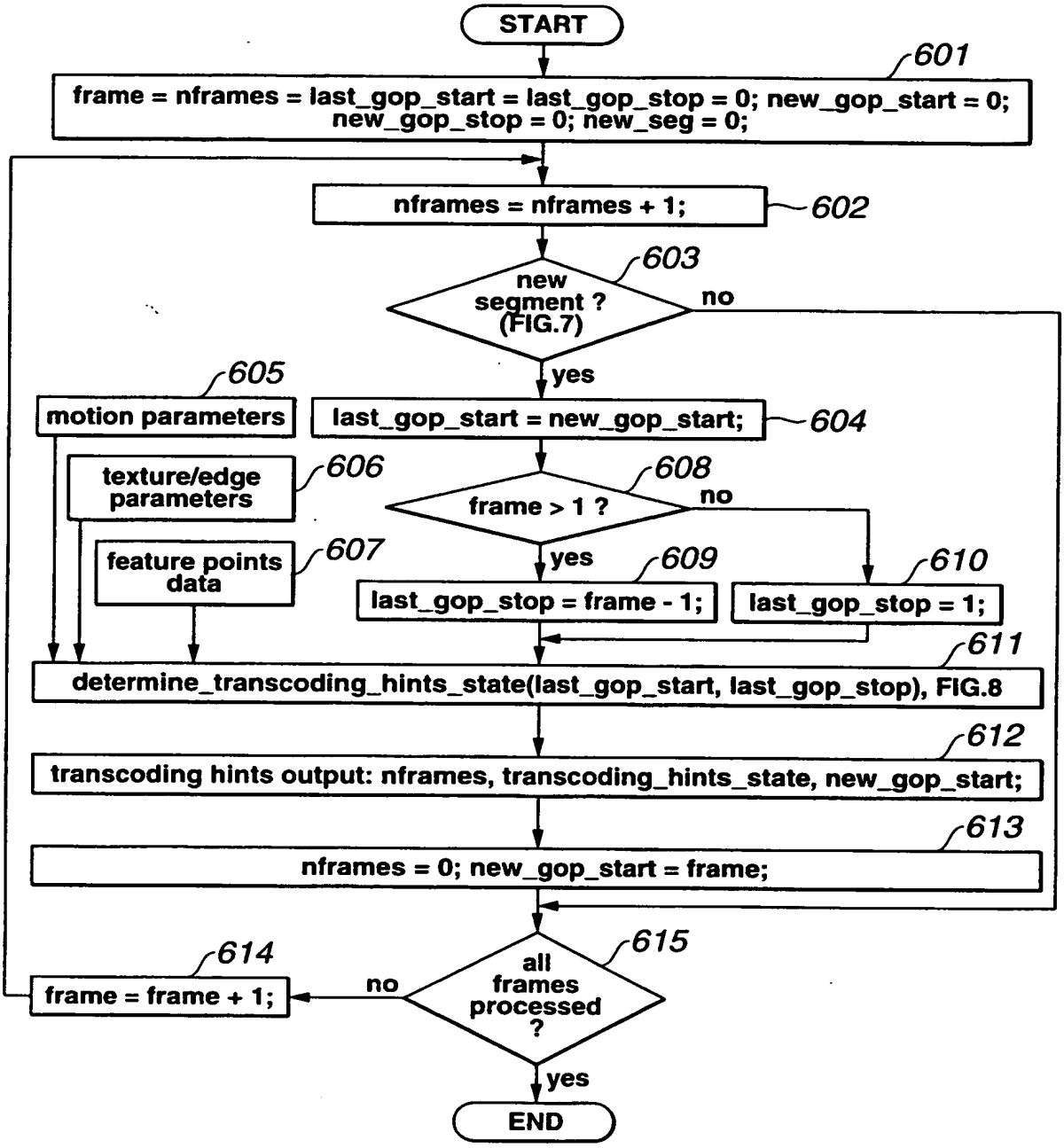

START
601
frame = nframes = last_gop_start = last_gop_stop = 0; new_gop_start = 0; new_gop_stop = 0; new_seg = 0;
nframes = nframes + 1;
602
603
new segment ? (FIG.7)
no
yes
605
motion parameters
last_gop_start = new_gop_start;
604
texture/edge parameters
606
608
frame > 1 ?
no
feature points data
607
yes
609
610
last_gop_stop = frame - 1;
last_gop_stop = 1;
611
determine_transcoding_hints_state(last_gop_start, last_gop_stop), FIG.8
612
transcoding hints output: nframes, transcoding_hints_state, new_gop_start;
613
nframes = 0; new_gop_start = frame;
614
615
frame = frame + 1;
no
all frames processed ?
yes
END

FIG.6

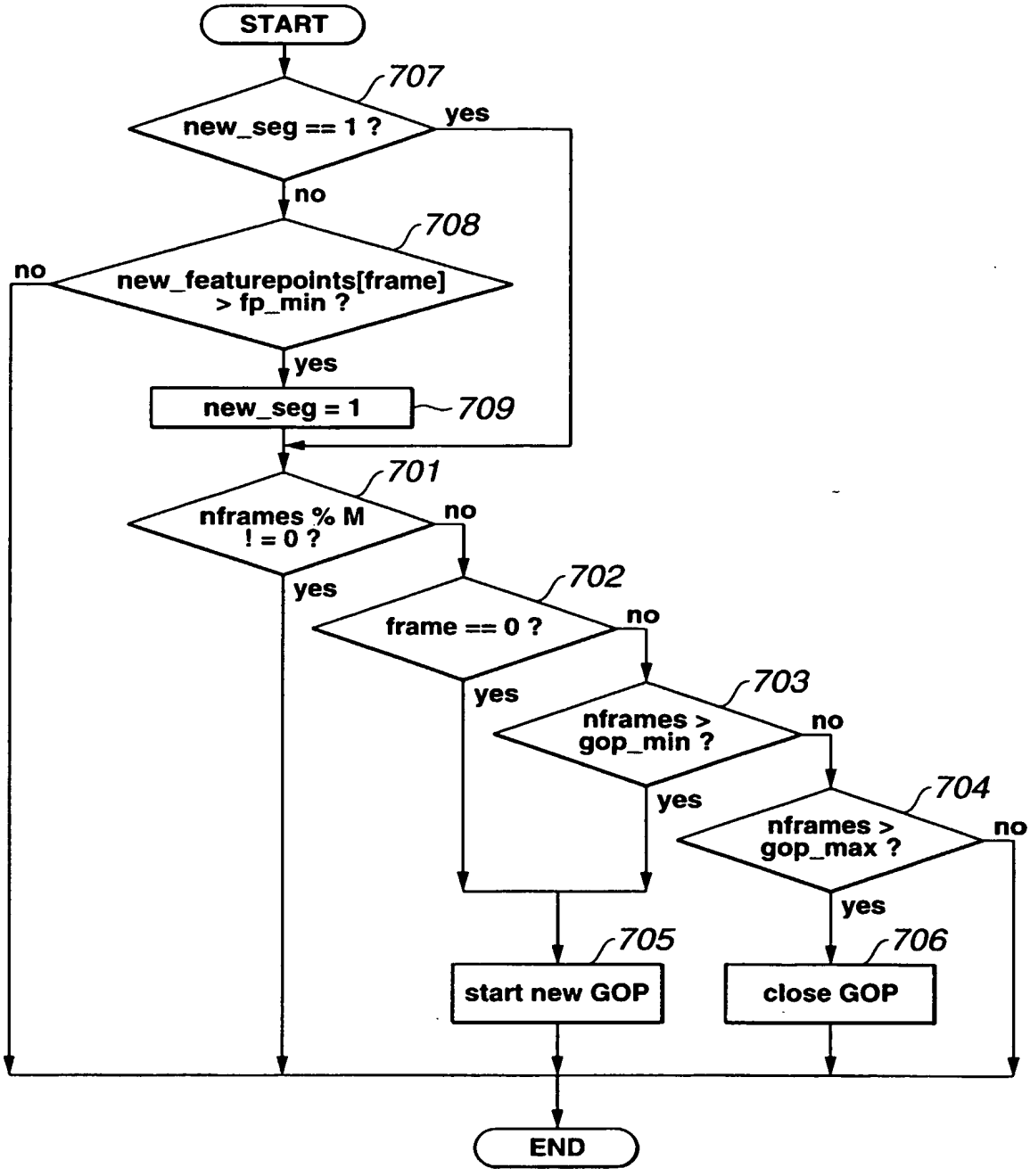

START
707
new_seg == 1 ?
yes
no
708
new_featurepoints[frame] > fp_min ?
no
yes
new_seg = 1
709
701
nframes % M ! = 0 ?
no
yes
702
frame == 0 ?
no
yes
703
nframes > gop_min ?
no
yes
704
nframes > gop_max ?
no
yes
705
start new GOP
706
close GOP
END

FIG.7

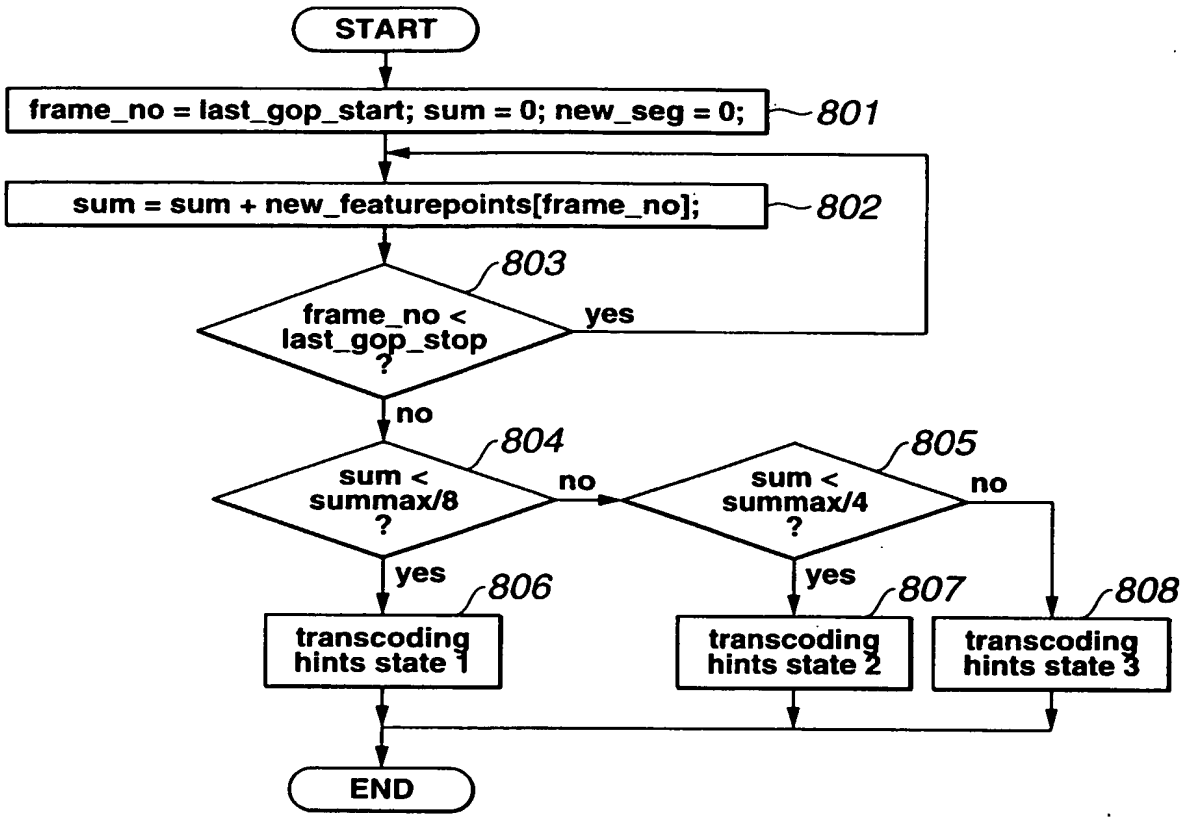


Table 1: Transcoding Hints State Table (example)

State	M	bitrate_fraction_for_I	bitrate_fraction_for_p
1	5	0.8	0.15
2	4	0.85	0.1
3	3	0.9	0.05

FIG.8

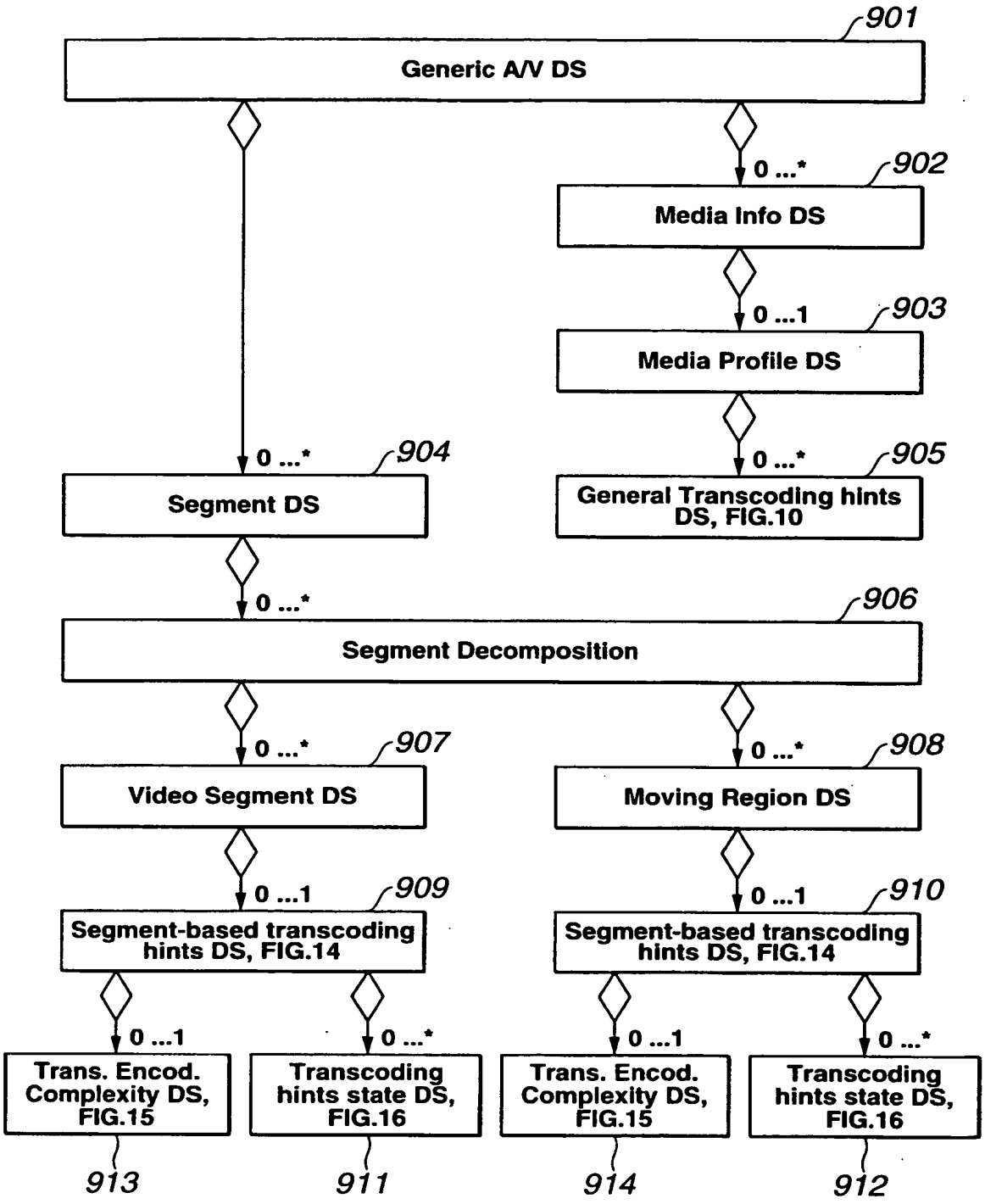

901
Generic A/V DS
0 ...*
902
Media Info DS
0 ...1
903
Media Profile DS
0 ...*
905
General Transcoding hints DS, FIG.10
0 ...*
904
Segment DS
0 ...*
906
Segment Decomposition
0 ...*
907
Video Segment DS
0 ...*
908
Moving Region DS
0 ...1
909
Segment-based transcoding hints DS, FIG.14
0 ...1
910
Segment-based transcoding hints DS, FIG.14
0 ...1
Trans. Encod. Complexity DS, FIG.15
0 ...*
Transcoding hints state DS, FIG.16
0 ...1
Trans. Encod. Complexity DS, FIG.15
0 ...*
Transcoding hints state DS, FIG.16
913
911
914
912

FIG.9

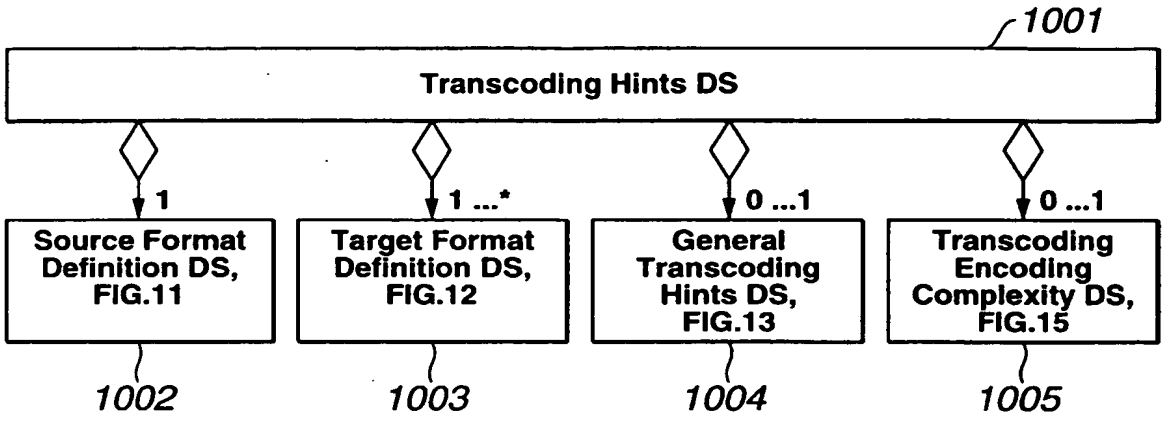


FIG.10

```
1: bitrate <int>
2: size_of_pictures <2*int>
3: number_of_frames_per_second <int>
4: pel_aspect_ratio <float>
5: pel_colour_depth <int>
6: usage_of_progressive_interlaced_format <1 bit>
7: usage_of_frame_field_pictures <1bit>
8: compression method <int>
9:      one out of list {MPEG-1, MPEG-2, MPEG-4, DV, H.263, H.261, .... }
10:     { further parameters for compression method }
11:     GOP_structure (Runlength coding)
```

FIG.11

```
1: bitrate <int>
2: size_of_pictures <2*int>
3: number_of_frames_per_second <int>
4: pel_aspect_ratio <float>
5: pel_colour_depth <int>
6: usage_of_progressive_interlaced_format <1 bit>
7: usage_of_frame_field_pictures <1bit>
8: compression_method <int>
9:        one_out_of_list {MPEG-1, MPEG-2, MPEG-4, DV, H.263, H.261, . . . . }
10:       { further parameters for compression method }
11:       GOP_structure (Runlength coding)
```

FIG.12

```
1:  use_region_of_interest_DS:  <1bit>
2:          region_of_interest DS:
3:             shape_D: select one or {boundary_box_D, MB_shape_D, shape_D}
4:             motion_trajectory_D
5:
6:   use_editing_effects_transcoding_hints_DS: <1bit>
7:          camera_flash {frame1, frame2, . . . . framek} <k*int>
8:          cross_fading {(start_frame, end_frame), . . . } <k*(<int>, <int>)>
9:          black_pictures {(start_frame, end_frame), . . .  <k*(<int>, <int>)>
10:         fade_in {(start_frame, end_frame), . . . } <k*(<int>, <int>)>
11:         fade_out {(start_frame, end_frame), . . . } <k*(<int>, <int>)>
12:         abrupt_change {frame1, frame2, . . . . framek} <k*int>
13:
14:  use_motion_transcoding_hints_DS:  <1 bit>
15:          number_of_regions:  <int>
16:             for_every_region:
17:                   is_region_rectangular_shaped  (y/n) :  <1bit>
18:                   if_arbitrarily shaped:  use region D for this region
19:                   describe parametric object motion for this region
```

FIG.13

```
1:  start_frame <int>
2:  nframes <int>
3:  I_frame_location:
4:          select_one_out_of_the_following: <2 bit>
5:                  first frame (default)
6:                  list of frames {frame1, frame2, . . . . , framek} <k*int>
7:                  first_frame_and_every_k_frames <int>
8:                  no_I_frame
9:  quantizer_scale <int>
10: target_bitrate <int>
11: target_min_bitrate <int>
12: target_max_bitrate <int>
13: use_transcoding_states (y/n) <1 bit>
14: transcoding_state_nr <int>
15: add_new_transcoding_state (y/n) <1bit>
16:             if yes: {list of parameters}
17: remove_transcoding_state (y/n) <1bit>
18:             if yes: state_nr <int>
19: use_encoding_complexity_description (y/n) <1 bit>
20:             if yes: encoding_complexity_description_scheme
```

FIG.14

```
1:  use_feature_points  (y/n)  <1bit>
2:        select_feature_point_method <2 bits>
3:              number_of_new_feature_points <nframes * int>
4:              feature_point_metrics {mean, max, min, var, stddev} <5* int>
5:  use_equation_description  (y/n)  <1bit>
6:  use_motion_description  (y/n)  <1bit>
7:        select_motion_method <4 bits>
8:              param_k_motion <nframes * k * int>
9:              motion_metrics {min, max, sum, var, stddev} <5*int>
10:             block_motion_field < nframes*int*size_x*size_y / (m*m) >
11: use_texture_edge_metrics  (y/n)  <1bit>
12:       select_texture_edge_metrics <4 bits>
13:             DCT_block_energy <size_y*size_x*nframes*int/64>
14:             DCT_block_activity <size_y*size_x*nframes*int/64>
15:             DCT_energy_metric {mean, min, max, sum, var, stddev} <6*int>
16:             DCT_activity_metric {mean, min, max, sum, var, stddev} <6*int>
```

FIG.15

```
1:  M: I/P distance <int>
2:  bitrate_fraction_for_I <float>
3:  bitrate_fraction_for_P <float>/* bitrate_fraction of B is rest to 100 %)
4:  quantizer_scale_ratio_I_P <float>
5:  quantizer_scale_ratio_I_B <float>
6:  if_frame:   /* see target format transcoding hints */
7:        X_I, X_P, X_B  <3*int> /* frame_vbv_complexities */
8:  if_field:
9:        X_I_top, X_P_top, X_B_top  <3*int> /* field_top_vbv_complexities */
10:       X_I_bot, X_P_bot, X_B_bot  <3*int> /* field_bottom_vbv_complexities */
```

FIG.16